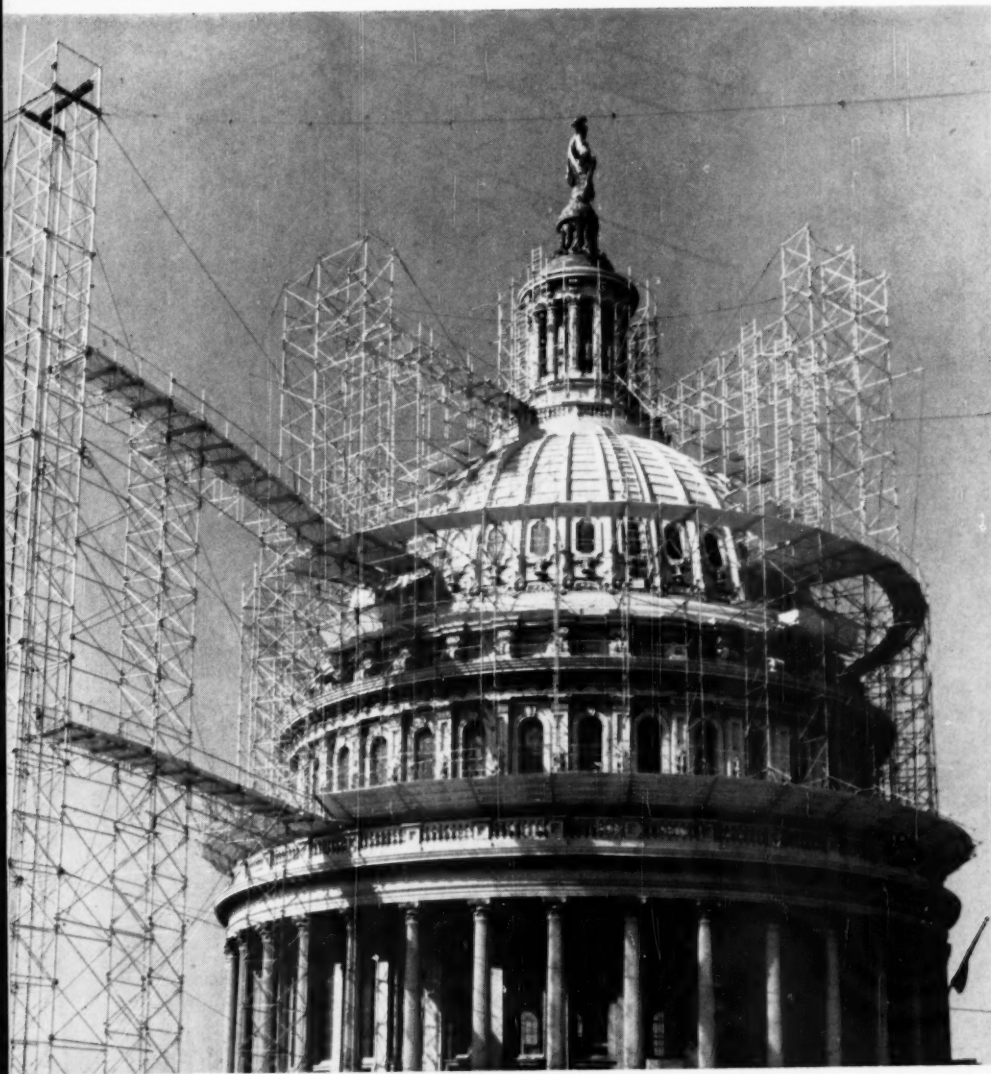


# Compressed Air

## Magazine



**FEBRUARY 1960**

**IN THIS ISSUE:**

A HELPING HAND FOR SALMON  
NONAGENARIAN SAWYER  
FROM STEAM TO AIR  
DIE QUENCHING  
COVER STORY AND INDEX, PAGE 3

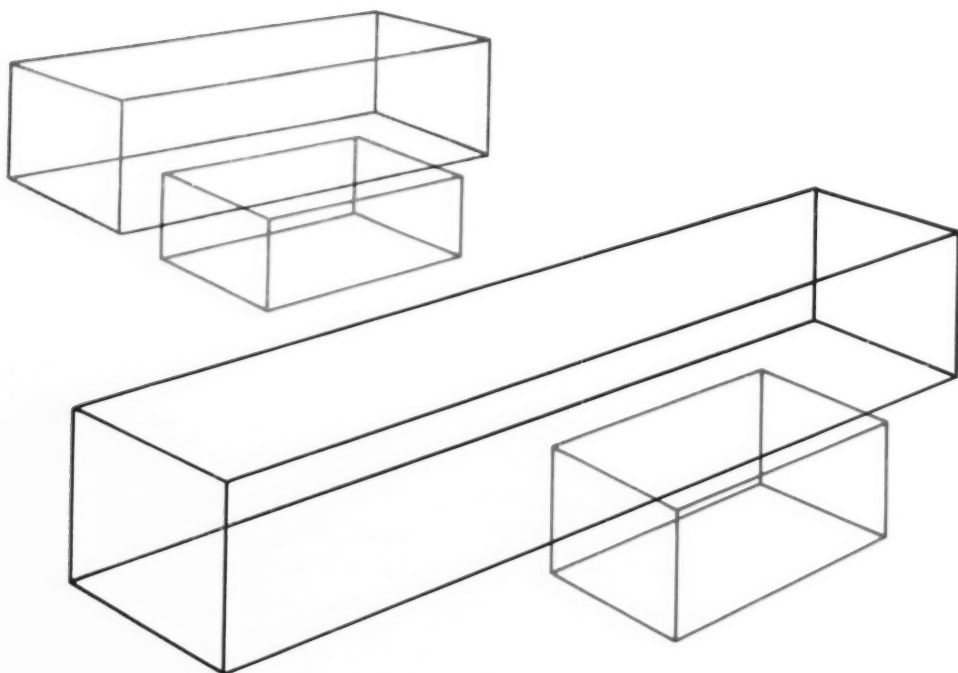
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COMPRESSED AIR MAGAZINE, PHILADELPHIA, PA.



## The problem of the diminishing ratio

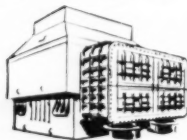
Twenty years ago, when 60 mw was a big generator, there was plenty of room in the foundation for the surface condenser. Even with round shell or heart-shaped units that didn't take full advantage of the rectangular opening, space was no problem.

But as generator capacity increased, so did the efficiency of the turbines. Energy output multiplied faster than physical size. Hence the ratio of available condenser space to generator capacity got smaller—and smaller—and smaller.

With the advent of the rectangular surface condenser, pioneered by Ingersoll-Rand, space problems were considerably eased. But the "squeeze play" is still going on—more and more

condenser capacity per cubic foot. Possible solutions to the problem include long, narrow designs installed crossways under a cross-compound unit, twin-shell arrangements, and side- or axial-exhaust units. Equally important, however, are the related factors of lowest possible back pressure at the turbine exhaust, lowest oxygen content and lowest condensate depression.

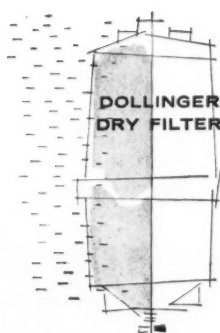
Whatever your condenser problem, it can benefit from Ingersoll-Rand's *experience* and *imagination in design*—aided by the most modern condenser design and research facilities in the world. Ask your Ingersoll-Rand engineer for complete information.



**Ingersoll-Rand**  
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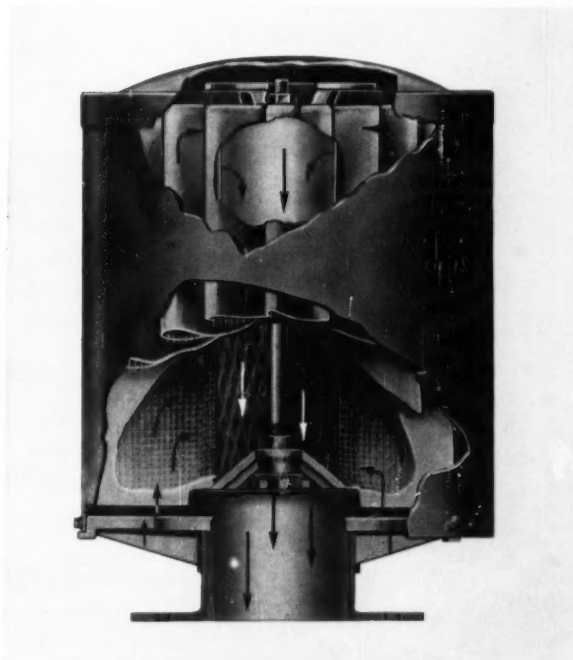


**DOLLINGER  
DRY FILTER**

**SPECIALISTS  
FOR 39 YEARS**

Filters for internal  
combustion engines,  
compressors  
and blowers

## **LOWEST INITIAL RESISTANCE OF ANY DRY-TYPE INTAKE FILTER**



**DOLLINGER STAYNEW FILTERS** are designed for direct application to engines, compressors and blowers or to outdoor piping without the need for foundations, supporting frames, or weather louvers. Staynew's Radial Fin Construction utilizes the very best filtering medium available. Offers the greatest active filtering area in any given space . . . low pressure drop with maximum efficiency . . . extended periods of service without maintenance. Threaded pipe connections or flanges make for ease and solidity of installation. For cleaning and inspection, the weather housing does not need to be removed—a small cover is taken off, a bolt unscrewed, and the insert merely lifted out; this is a major advantage in the case of very large models. Available with capacities ranging from 60 to 10,000 C.F.M. Multiple units available for larger capacities. Write for Intake Filter Bulletin 100. Dollinger Corporation, 7 Centre Park, Rochester 3, New York.



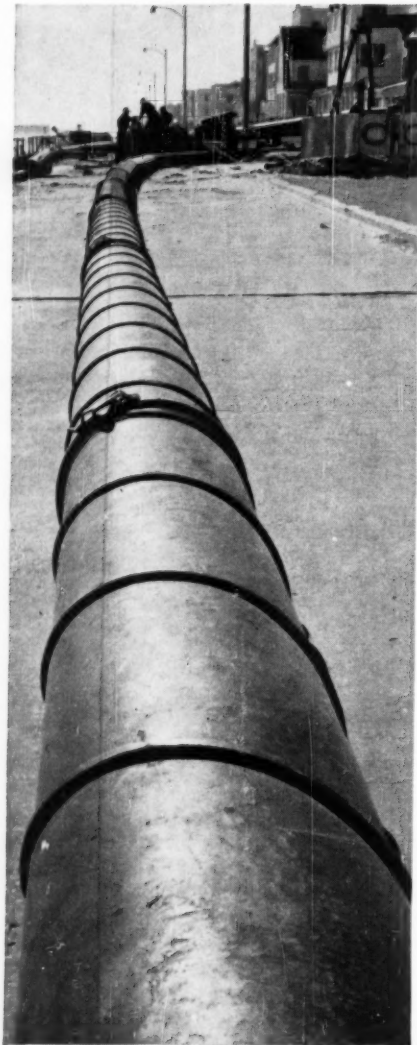
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# READ The Facts BETWEEN THE LINES!



NAYLOR Spiralweld pipe is easy to handle and install.



Its distinctive spiral-lock-seam structure provides a lightweight pipe without sacrifice of strength and safety.

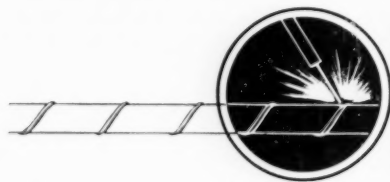
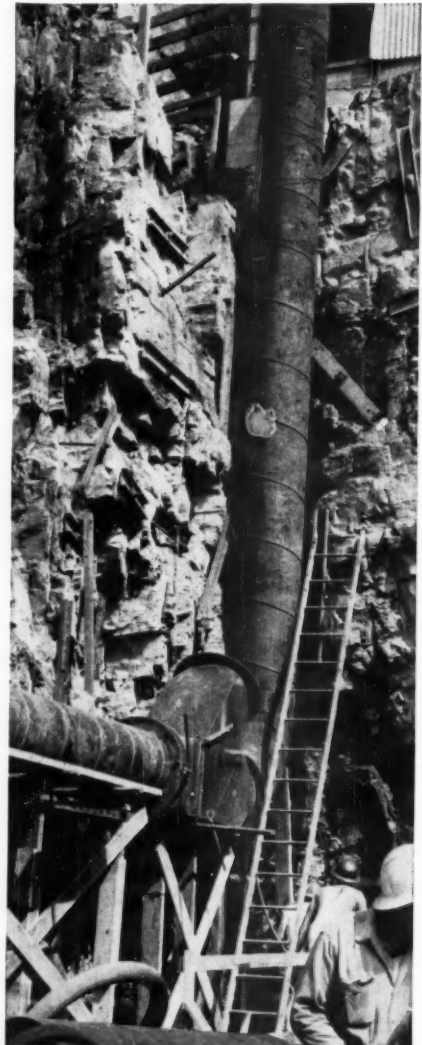


Lines are made up faster when you make connections with NAYLOR Wedgelock couplings.



For handling water or air, for moving material, or for ventilating service—it will pay you to look into this NAYLOR pipe and coupling combination.

Bulletin No. 59 gives all the facts. Write for it today.



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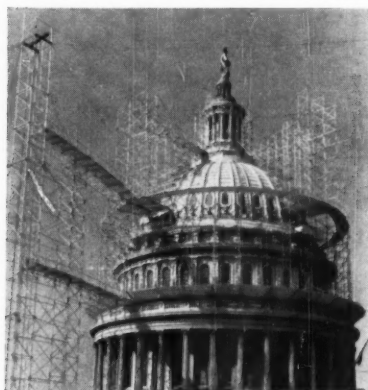
# Compressed Air

MAGAZINE

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## on the cover

CURRENTLY undergoing repairs in Washington, D. C., is the nation's Capitol Building. The structure is familiar to everyone in the country and is now 167 years old, counting from the laying of its cornerstone by President Washington in 1793. The present cast iron dome that replaced an earlier copper-covered frame structure is itself almost 100 years old, being completed in 1865. Because of the uncertainty of engineers as to its ability to support any weight in addition to the 14,985-pound bronze Statue of Freedom that surmounts it, the refurbishing has had to be done entirely from the elaborate scaffolding shown. Universal Manufacturing Corporation designed and built the framework for the general contractor, J. F. Fitzgerald. More than 20,000 scaffolding components were used along with 10,000 feet of guy lines.

## 14 Helping Salmon to the Sea—Ivan J. Donaldson

When dams were thrown up on the Columbia during the 30's biologists began studying the mortality of small salmon passing downstream through turbine and spillway. The fish represent natural resources of an industry worth \$30 million annually. In this article Author Donaldson tells his problems and successes.

## 20 Oldest Sawmill Has New Ideas—Clee Woods

Learned Sawmill began ripping logs in 1825 and has been at it ever since. Although old in experience—it has survived debts, the Civil War and the travail since—it always has adopted the newest in equipment. An air-steered tugboat and an air-powered log bucket are among its recent innovations.

## 22 From Steam to Air—Walter Rudolph

A veteran sandboat is the *Niagara*. She began life as a steam vessel on the Great Lakes but has been converted to diesel-air. Two rotary compressors, totalling 1200-cfm capacity, provide air to operate the boat's winches, pumps, steering, gear, etc.

## 25 Fast Freeze for Hot Parts

Ryan Aeronautical Company has developed a new die-quenching process that speeds up forming of heat-resistant alloys by ten times. Using subzero compressed air and a tank, the die can be kept cold so successfully that it can be worked constantly.

## 28 Golden Beavers Awards for Six

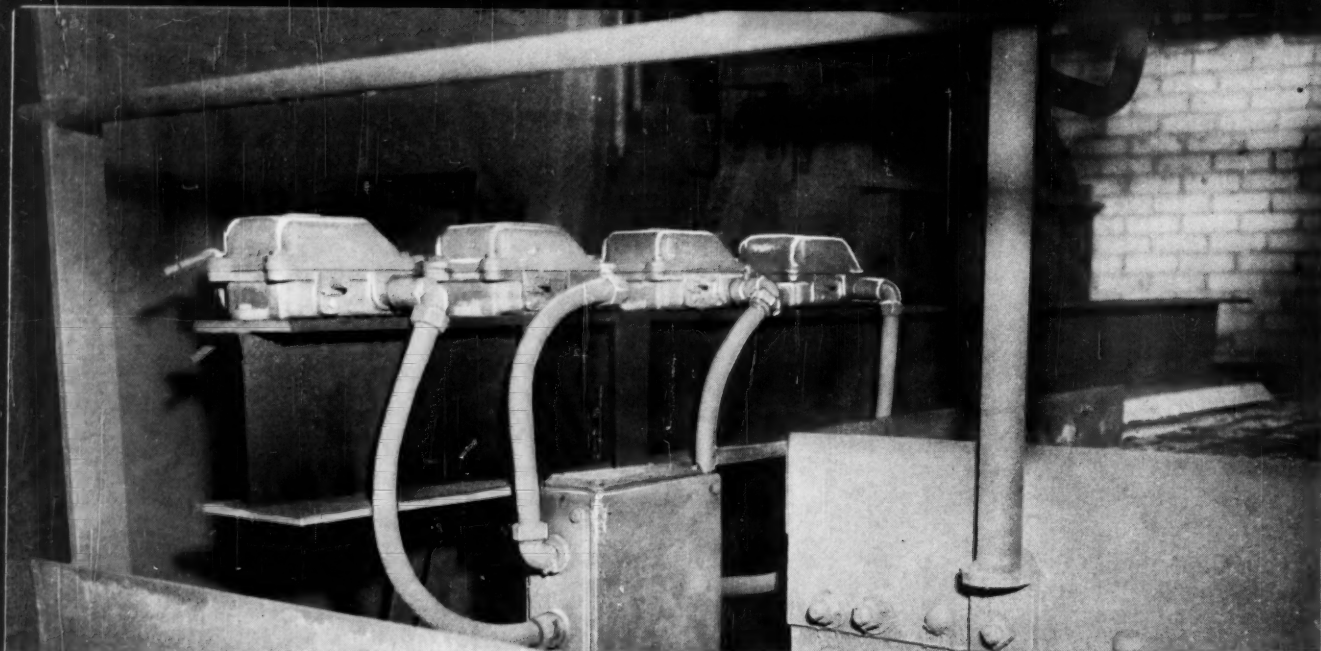
For their outstanding contributions to the field of construction these men have received annual awards given by the Beavers.

## 32 Air Jets—Variations on a Theme

Air spurts clean machines, blow away water, dislodge stored materials. They also can neatly break sheets from a veneer lathe.

## Departments

- 26 This and That
- 27 Compressed Air Oddities
- 29 Editorial—Birthday for Hoover Dam
- 30 Saving With Air Power Applications
  - Clearing Barber Cuttings
  - Splitting Sandstone
  - Processing Vegetables
- 33 Industrial Notes
- 43 Index to Advertisers



**COAL CAR DUMPER SWITCH CABLES** are protected from coal dust, moisture and weather by  $\frac{3}{4}$ -inch Sealtite.

## DUKE POWER SEALS OUT 6,000 FEET OF POTENTIAL TROUBLE

Coal dust, dirt, moisture, weather — it's pretty hard to keep them out of a power station — even harder to keep them from causing wiring trouble. But Duke Power has done it by sealing 6,000 feet of crucial wiring in Sealtite at the new Charlotte, N. C., Power Station.

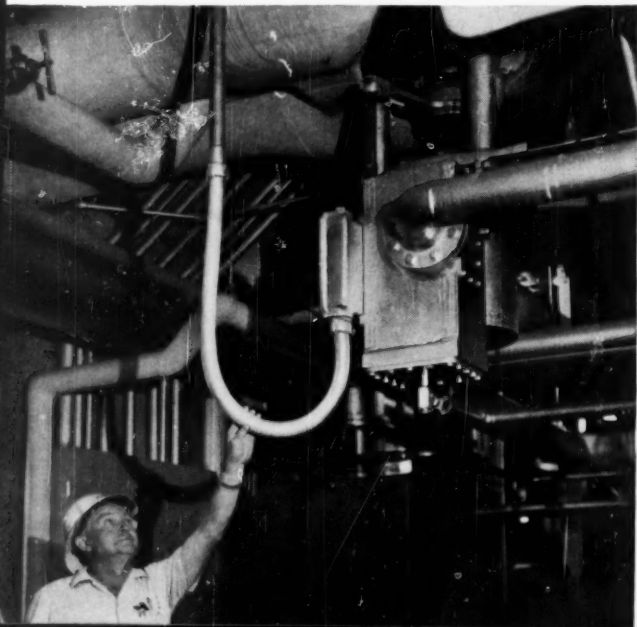
Even the roughest day-in, day-out weather doesn't disturb this flexible, liquid-tight conduit. Its tough extruded polyvinyl chloride jacket proves itself in arctic cold or tropical heat. It resists moisture, oil, dirt—even

salt spray and corrosive chemical fumes. Sealtite's flexible metal interior dampens vibration. That's why it often outlasts rigid conduit.

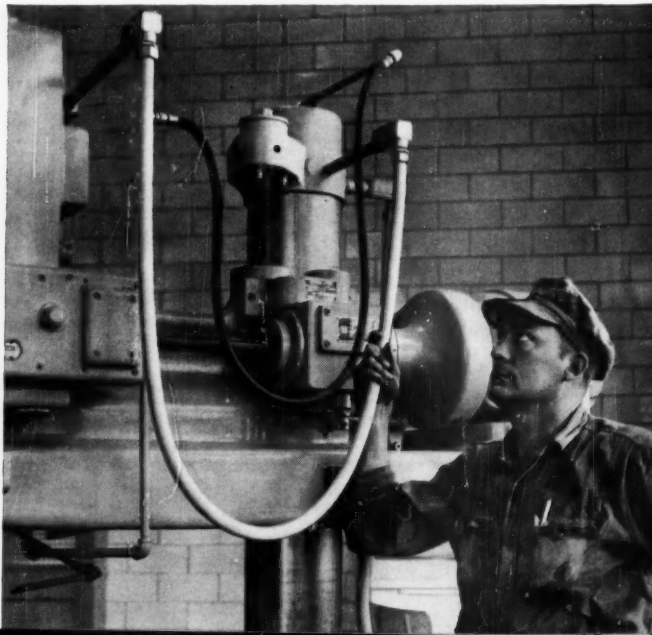
Look over the examples to see how Duke Power takes full advantage of Sealtite. Perhaps one of them might suggest a way you, too, can increase your wiring efficiency by eliminating potential trouble spots.

**WHERE TO GET SEALTITE**—Electrical Wholesalers stock Types U.A. and E.F. Sealtite in easy-to-handle coils,

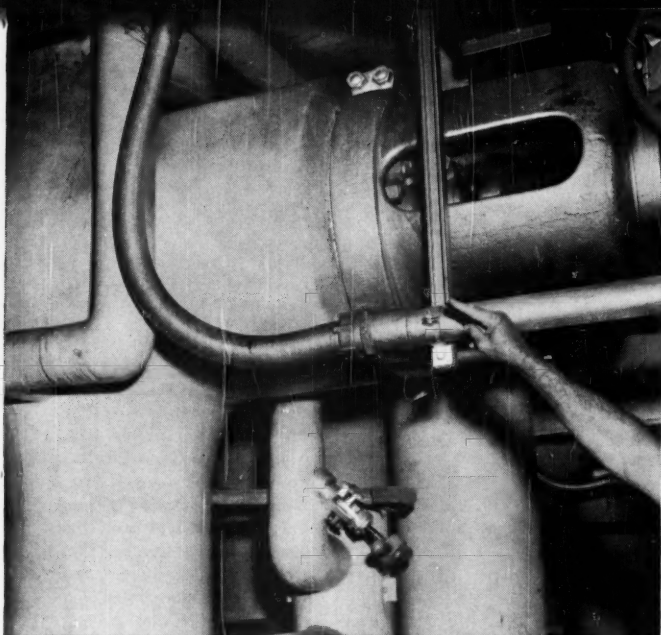
**RE-HEAT VALVE CONTROL BOX CONNECTIONS** are protected in  $1\frac{1}{2}$ -inch Sealtite to accommodate re-heat line expansions.



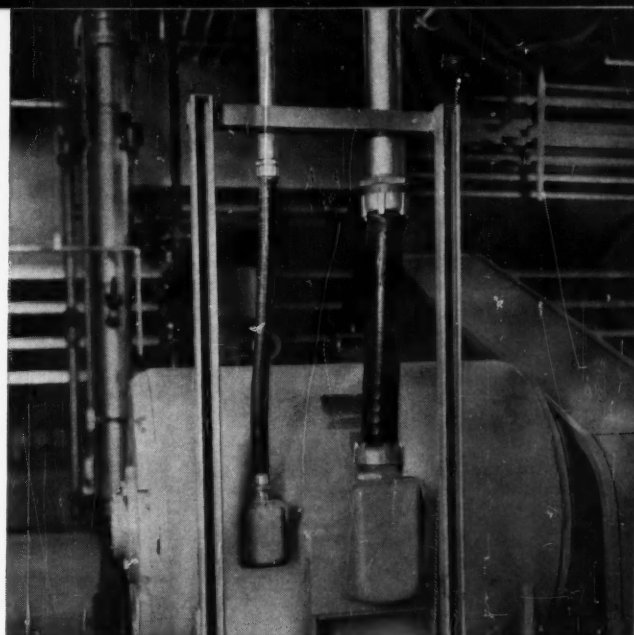
**RADIAL DRILL CONNECTIONS** are protected in 1-inch Sealtite for maximum flexibility, easier motor repair and replacement.







**BOILER CIRCULATING PUMP CONNECTIONS** are protected from movement due to expansion by 2½-inch Sealite. Rigid conduit would crack.



**COMPRESSOR CONNECTIONS** are protected in 1- and 2½-inch Sealite. Flexibility is a must because the motor is moved for belt adjusting.

## WITH SEALTITE FLEXIBLE, LIQUID-TIGHT CONDUIT

in black or gray. Be certain you ask for and get the quality conduit marked "Sealtite" and "Anaconda" on the cover. Buy it in long lengths on reels or in cartons and cut it on the job without waste. Your wholesaler also stocks liquid-tight connectors. Free Booklet S-542 gives full information on Sealite. Write: Anaconda Metal Hose Division, The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. Sealite is approved by Canadian Standards Association.

89141



**CUTAWAY SECTION** of Type U.A. Sealite shows tough polyvinyl chloride jacket over flexible metal core. Copper conductor wound spirally inside conduit gives positive ground.

Insist on the conduit marked

# SEALTITE®

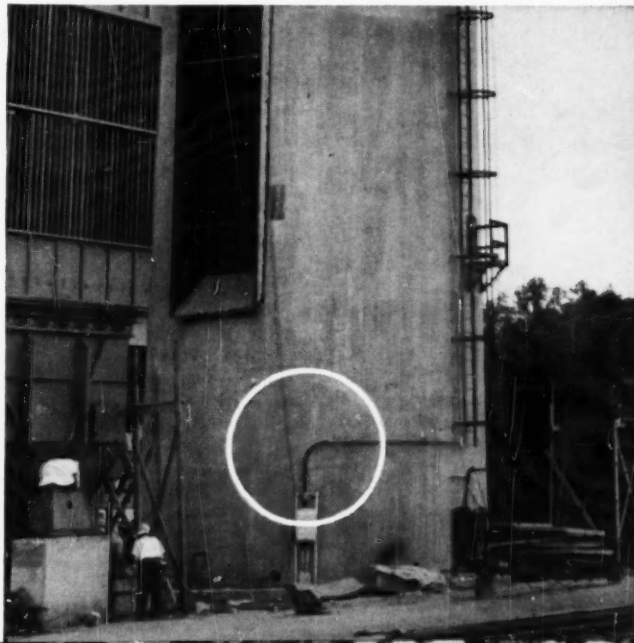
Flexible, Liquid-Tight Conduit

AN  
**ANACONDA®**  
PRODUCT

**TRANSFORMER** is connected to terminal boxes by 4-inch Sealite because it can be easily disconnected, simplifying repairs.



**SMOKE STACK LIGHTING WIRING** protected by ½-inch Sealite which offers ease of installation and ability to withstand weather.



# COMPLETE I-R DRILL TEAM

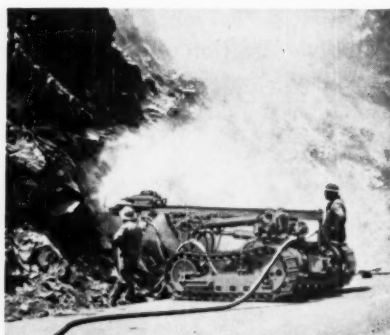
## Speeds Sierra Highway



**TWO I-R DRILLMASTERS** put down vertical blast holes for new Route 40 in the high Sierras between San Francisco and Reno. These completely self-contained drilling units, embodying 600 cfm Gyro-Flo compressors and I-R Downhole drills, take any terrain in stride, spot holes on a dime, maintain high drilling speed and long bit life in any type of rock.

By supplying all drilling equipment, from bits to compressors, Ingersoll-Rand offers a one-source service that saves time and effort, simplifies procurement and provides skilled application engineering and field service wherever and whenever it is needed.

**600 cfm GYRO-FLO COMPRESSOR** provides abundant, dependable and low-cost air power for the Crawl-IR drill shown at the right. These Ingersoll-Rand portable rotary compressors set the highest standards for simplicity, ease of operation and freedom from maintenance.



**ONE OF THREE CRAWL-IR DRILLS** on the Sierra Highway job, shown here drilling horizontal blast holes in a rock face. The mobility and completely mechanized operation of these rugged, heavy-duty drills converts set-up time to drilling time.

**TRUCK-MOUNTED 315 cfm GYRO-FLO** provides air for **TWO HEAVY-DUTY JACKHAMER DRILLS** to speed secondary drilling of large rocks and boulders. Here, traditional Jackhammer stamina keeps drills on the job and out of the repair shop.



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A CONSTANT STANDARD OF QUALITY IN EVERYTHING YOU NEED FOR DRILLING ROCK



**Bethlehem Rope on West Virginia Highway**—Interstate 77 is an important link now taking shape in West Virginia's growing network of express highways. A north-south, 4-lane route connecting Parkersburg and Charleston, the new road will offer motorists a direct tie-in with the West Virginia Turnpike. This picture was taken recently during rough grading near the site of the Goldtown Interchange, near Sissonville, performed by Harrison Construction Company, Pittsburgh, Pa. Husky Bethlehem Wire Rope in various sizes is used here extensively, not only on drop-ball cranes, but also on draglines and shovels, scrapers, and bulldozers.

*Bethlehem Steel Company, Bethlehem, Pa. Export Distributor: Bethlehem Steel Export Corporation*

*Mill depots and distributors from coast to coast stock Bethlehem Wire Rope*

**BETHLEHEM STEEL**





**NEW!**

# **SCHRADER INDUSTRY-INTERCHANGEABLE HI-FLO\* AIRLINE COUPLER!**

**SAFE PUSH-PULL OPERATION  
ACCIDENTAL UNCOUPLING NO LONGER A PROBLEM!**

Schrader's new quick-acting couplers are full of features that afford the best air service. Safety's built in . . . it won't open accidentally even when dragged on the ground and snarled on a piece of machinery . . . yet the heavily knurled new coupler connects and disconnects in a single upstream push or pull with one hand, *gloved or greasy!*

More features: fastest air flow . . . non-corrosive . . . case hardened steel all through . . . meets and exceeds military specs . . . engineered for simple, easy replacement of parts in the field.

Important: Schrader's new coupler is interchangeable with others of similar type. A variety of end fitting styles are available. See your supplier soon.

## **NEW COUPLER CHECK UNITS AND ADAPTERS**



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FEMALE



#5138-12-1/4 N.P. MALE  
#5140-12-3/4 N.P. MALE



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MALE



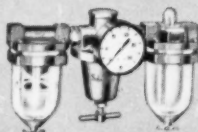
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FEMALE



#5140-11-SERRATED SHANK  
FOR 3/4 I.D. HOSE

## *... added to these quality Schrader Accessories*

**SCHRADER HOSE REELS** work like window shades. Tuck hose away automatically. No. 3481 is Air Tool Suspension Type.



**SCHRADER LUB-AIR-ATOR** does 3-way job: filters, lubricates, regulates. Keeps systems operating smoothly.



**SCHRADER STANDARD COUPLERS WITH FASTER FLOW** are now being shipped.



**SCHRADER LEVER TYPE BLOW GUN** offers precision control, from a gentle puff to a full blast.

**SCHRADER BUTTON TYPE BLOW GUN** is all-purpose, easy-operating, with durable forged brass body.



\*Reg. U. S. Pat. Off.

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**A. SCHRADER'S SON**  
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**QUALITY AIR CONTROL PRODUCTS**

COMPRESSED AIR MAGAZINE



You  
years  
with an



# A TRACTOR WITH GUTS AND INTEGRITY!...

In any piece of equipment there are vitally important components and engineering developments not apparent to the eye. Only after years of hard and strenuous use, does their strength or weakness become apparent . . . and inscribe itself on your profit and loss statement!

One of the important features of the modern Eimco line of crawler-tractors is the broad use of heat treated alloy steels, for greater strength and resistance to metal fatigue. Instead of using cheaper iron castings, Eimco produces highest quality, carefully controlled steel in its own electric furnaces, under highly skilled metallurgists.

In an Eimco, the track shoes, sprockets, idlers, track rollers and equalizer bars are all produced in Eimco's vast and modern plants from heat-treated cast alloy steels, and other components from special steels, tailor-made by Eimco for their particular end-uses. One

of the results has been a record of over seventy per cent savings on maintenance and parts costs by Eimco operators, as against the average for any other leading make of crawler-tractors!

You can easily see many of the Eimco exclusives, such as Up-front Operator Position; "Uni-drive" transmission at work, for flip-of-the-lever shifting, forward or reverse; Dual Final Drives for maximum maneuverability and true spin turns and others.

But remember, under these unique and important features, is the heart . . . the guts . . . of any tractor. The integrity, quality and craftsmanship of the manufacturer. Eimcos are built to a standard that permits a full year guarantee on the entire tractor and transmission.

So step up your work output . . . and profit . . . with the modern and efficient line of crawler-tractors . . .

**Eimco 103**  
100 HP

**Eimco 105**  
143 HP

**Eimco 106**  
205 HP

"ADVANCED ENGINEERING AND QUALITY CRAFTSMANSHIP SINCE 1884"

## THE EIMCO CORPORATION

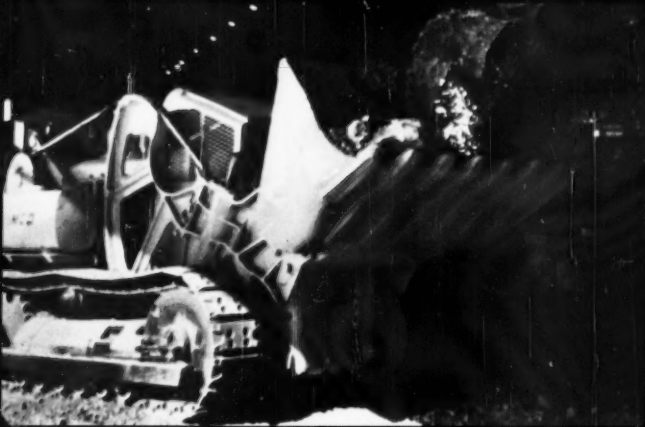
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## TRACTOR LOADER DIVISION

634 SOUTH 4TH WEST  
SALT LAKE CITY, UTAH — U.S.A.

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Shown above, is the Eimco 103 Dozer, one of the great machines in this Eimco 100 HP series of crawler-tractors. Available as a basic Tractor, in twelve models of Dozers, as Model 123 Front End Loader and the Eimco 133 Special Steel Mill FEL and the 143 Log Loader.

Eimcos can take it! Every major steel mill has found that Eimco Loaders, such as the Eimco 115 Excavator shown here, will outproduce, outload and outlast any other loader... will keep producing and performing, with minimum maintenance, year after year. The famous 105 series is powered by 143 HP GMC Detroit Diesel or 130 H.P. Cummins Diesel engine of latest, modern design. Available as Tractor, Dozers, Excavators, Special Mill Excavators and Front End Loaders.

*Get all the facts! Contact the Eimco Dealer or Branch nearest you, or write The Eimco Corporation, P. O. Box 300, Salt Lake City 10, Utah, U.S.A.*



Powered by the newest V-6 diesel engine, the 106 series features the most practical Front End Loader and Log Loader offered today. Combining maneuverability and speed with the power of 205 HP, the Eimco 106 series is available as a Tractor, all types of Bulldozers, Front End Loader (Model 126), Special Steel Mill FEL (Model 136) and, as pictured, Model 146 Log Loader with all Forestry Department approved attachments.





*As easy as plugging in your electric shaver...*



with  
**INSTANT**  
AUTOMATIC FLOW  
or  
SHUT-OFF

**QUICK**  
FLUID LINE  
CONNECTION  
or  
DISCONNECTION

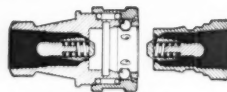
# HANSEN

SERIES HK QUICK-CONNECTIVE  
**TWO-WAY SHUT-OFF**  
COUPLINGS

Hydraulic and pneumatic lines are quickly and easily connected with Hansen Series HK Two-Way Shut-Off Couplings. No tools required.

When Coupling is disconnected, valves contact valve seats in both Socket and Plug to provide instant and positive seal of fluid in both ends of line. Coupling does not depend upon line pressure to seal either end of line.

Six sizes are available, with female pipe thread connections from  $\frac{1}{8}$ " to 1" respectively. Furnished either in steel or brass.



Instantly shuts off both sides of line... prevents loss of liquid, gas or pressure.

## Quick-Connective Fluid Line Couplings for

COMPRESSED AIR • HYDRAULIC FLUIDS  
WATER • VACUUM • STEAM • OXYGEN  
ACETYLENE • REFRIGERANTS • GASOLINE  
OIL • GREASE • COOLANTS • LP-GAS



## Write for the Hansen Catalog

Here is an always ready reference when you want information on couplings in a hurry. Lists complete range of sizes and types of Hansen One-Way Shut-Off, Two-Way Shut-Off, and Straight-Through Couplings.

*Representatives in Principal Cities... See Yellow Pages*

SINCE 1915



QUICK-CONNECTIVE FLUID LINE COUPLINGS

**THE HANSEN**

**MANUFACTURING COMPANY**

4031 WEST 150th STREET

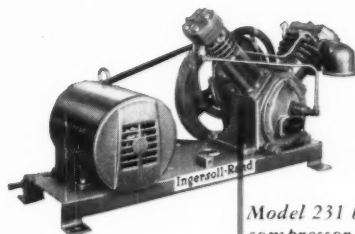
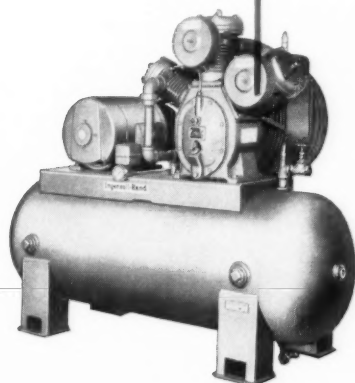
CLEVELAND 35, OHIO



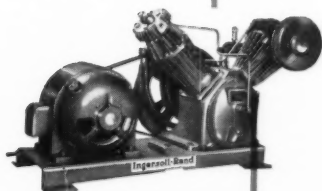
# high pressure COMPRESSED AIR

...in small quantities  
from small air-cooled compressors

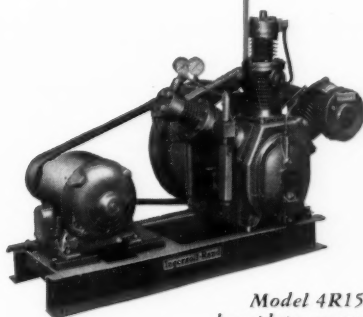
*Model H15TE tank mounted  
compressor will deliver air  
at 250 psig pressure.*



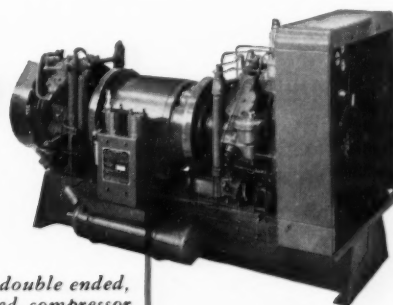
*Model 231 baseplate mounted  
compressor will deliver air  
at 500 psig pressure.*



*Model 41 baseplate mounted  
compressor will deliver air  
at 1000 psig pressure.*



*Model 4R15 double ended,  
baseplate mounted compressor  
will deliver air at 5000 psig pressure.*



*Model 15T3 baseplate mounted  
compressor will deliver air at  
3000 psig pressure.*

**1½ through 25 horsepower  
250 to 5000 psig pressure**

For air blast circuit breaking, air starting of engines, valve test stands, accumulator service, oil field rigs, air craft support equipment, etc., Ingersoll-Rand can supply compressors, off the shelf, specifically designed for high pressure operations.

Proper selection of high pressure compressors is important. Duty cycle, minimum and maximum running time and intended maintenance are all important factors. Ingersoll-Rand makes these compressors to give you exceptional value in a most compact, economical and dependable design.

Your local Ingersoll-Rand sales engineer is experienced in the field of high pressure compressors and is prepared to assist you in choosing the proper compressor for your application. See him today or write to—

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**OTHER I-R HIGH PRESSURE COMPRESSORS TO 7500 HP-PRESSURES TO 35000 PSIG**

# Helping Salmon

Ivan J. Donaldson,  
Fisheries Research Biologist,  
U.S. Army Corps of Engineers



**LANDING SALMON** The two pictures on this page show salmon being retrieved at Bonneville Dam after their trip through the turbines. Above, a balloon-bag unit is scooped up. In the overhead view at left, one man holds the net, another lifts out the fish, and a recorder writes data of the take on his pad. Containers in the boat hold recovered fish and balloons.



# to the Sea

**E**ACH SPRING fingerling salmon in the chill, swift waters of the Columbia River feel an instinctive migratory itch. As their ancestors have done for thousands of years, they must swim to the salt waters of the Pacific where they will pass the greater part of their adult lives. The young fish respond to the urge. They quit their fresh water haunts and flash downstream to the sea.

Their journey is important to man as well as to the fish. The salmon that make this run down the Columbia, and the adult fish that each summer fight their way upstream to spawn, are the raw material for an industry annually worth some \$30 million. People in the fishing boats and the canneries hope the fish make the trip safely.

When Bonneville Dam was being built 140 miles upstream from the Pacific during 1933-1937, many cries went out for the welfare of the salmon. Consequently the U. S. Army Corps of Engineers, the agency building the dam, took steps to safeguard the migrants. To allow adult fish to return to their early fresh-water homes where they would spawn, three

**SEA MULE** Framed in Bonneville's spillway crane, a "sea mule" works the turbulent waters, picking up carp that have been given the balloon test in lieu of salmon.

40-foot-wide fish ladders and six fish-lift locks were built. Also, provisions were made at the navigation locks to raise the fish to forebay level. The old fish fared well.

At the same time four fingerling bypasses were constructed to shunt the youngsters downstream past the turbines and spillway. It was learned, however, that only a small percentage of the millions of young fish discovered the bypasses. This meant that most of them passed through the turbines and under the spillway gates.

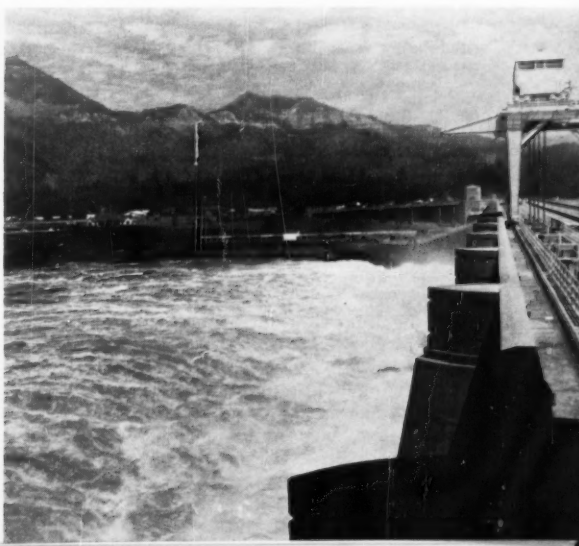
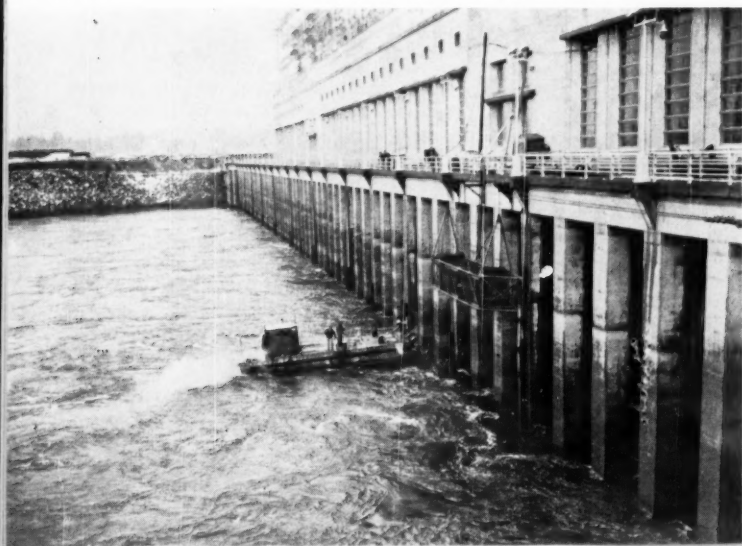
Fears that the fish would disappear as a result of Bonneville and subsequently built dams proved to be a stimulus to research into finding ways to sustain

salmon and steelhead trout populations. Studies have been made for the past 2 decades to determine the percentage of mortality of the young fish swimming through Francis and Kaplan types of turbines. Since 1937, commercial fishing groups, hatcheries, the Oregon, Washington and Idaho state fisheries and game commissions, the two states' colleges and universities, the U. S. Fish & Wildlife Service and the Corps of Engineers have worked on the problem.

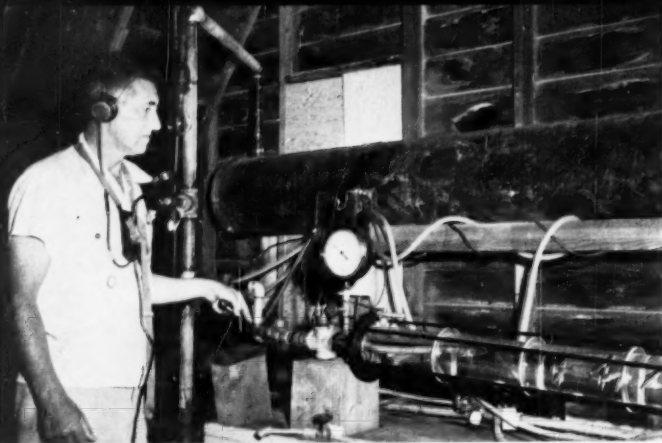
One long-term study at Bonneville (whose results have not yet been published) was made by Dr. Willis Rich, preliminary work having been done by Arnie J. Suome'a and Harlan B. Holmes. A large number of fingerling salmon

**POWERHOUSE, SPILLWAY** Picking up fish, the "sea mule" nudges close to the discharge of the Bonneville powerhouse, below left. At right, water rushes from the Bonneville

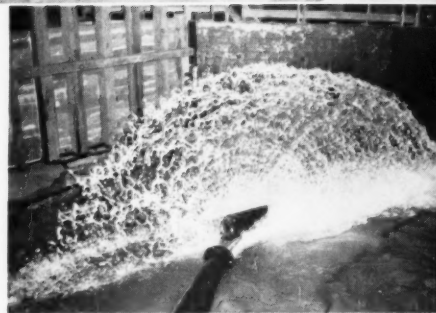
spillway to create the "trough" that captured balloons. Washington State mountains loom in the distance in this photograph. At shore is part of Bonneville's fish-ladder system.







**TOUGH TESTS** Fingerling salmon were given pressure, impact and vacuum tests to learn hardiness. At left the fish, visible in the plastic cylinder at lower right, receive 18 psi added pressure. A headspace of compressed air was held against the water overnight. Not pressure but sudden changes of pressure were found most harmful. The other two pictures show the impact tests. Fish were unhurt when thrown from the long nozzle at 46 feet per second against a steel plate. Upper right, the position for a head-on (90-degree) test; at right, a 45-degree test is in process. In vacuum studies (not pictured) fish were put through an 8-inch venturi housing a near-perfect vacuum. Despite deafening cavitation, fish survived.



was placed in the river immediately above Bonneville so that the fish were compelled to pass through the turbines and spillway to seek the ocean. (The Columbia River channel at Bonneville is divided by a midstream island. A long spillway dam runs from the north or Washington shore to the island. A powerhouse joins the island to the south or Oregon shore.) Certain fins had been removed from these fish to mark them. An equal number, a control group, was marked differently and put in the river below the dam. The biologists waited 3 to 5 years for the marked fish to return to their parent river and hatcheries. A reward of 50 cents a fish was paid to anglers and to workers who returned marked fins discovered in commercial fishing boats or canneries. The researchers hope to determine mortality of fingerlings going through the turbines by comparing the number of both groups that came back.

## Kaplan Turbines

The turbines at Bonneville are the Kaplan type, 23 feet in diameter. Such units usually revolve at speeds of less than 200 rpm. There are wide spaces between the stay supports, wicket gates and the turbine blades. The blades travel about  $\frac{3}{16}$  of an inch from the metal of the throat ring of the draft tube and this is the only place where a fish might be caught. However, the creation and collapse of vacuum pockets—cavitation—occurs on the bottom of the leading edge of some of the runners or turbine blades. Such cavitation suggests to engineers and biologists that fish might be injured by pressure changes. Laboratory work has indicated that negative pressures (vacuums) and very sudden pressure releases are harmful to small fish.

A more recent study began in 1955. The Washington State Department of Fisheries tattooed small salmon with various colors of pigment (titanium dioxide and two colors of ferric oxide). These fish were released above and below McNary Dam (also located on the Columbia). Large scoop nets, supported on pontoons at points 1 mile, 20 miles and 50 miles below the dam, recaptured samples of the test and control fish soon after their release. Evaluated statistically, the returns indicated about 11 percent of the fingerlings died passing through the turbines, and that no significant loss of fish occurred in the spillway. This investigation, which cost about \$150,000, was carried out by the state under contract with the Corps of Engineers as part of the Corps' Fisheries Engineering Research Program.

While working with Holmes in 1941 and 1942 on the original mortality experiment, I began looking for a means of passing the small fish through the turbines and recovering them below the dam a few minutes after their release. It occurred to me that if the fish went through the turbines in a gossamer bag fragile enough to give them no protection, the fingerlings could be recovered for examination by means of delayed inflation of a rubber balloon. Before tests could begin, we had to be sure the fish would survive in the bag prisons, and we had to perfect a method that would inflate the balloon at the right time.

Prior to World War II, several methods of delaying the inflation of the balloon were investigated. After the war the experiments were resumed.

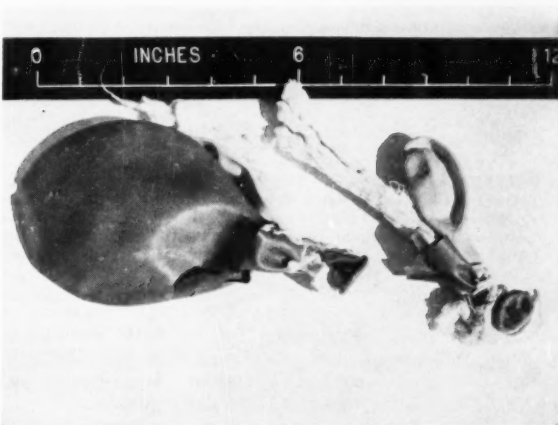
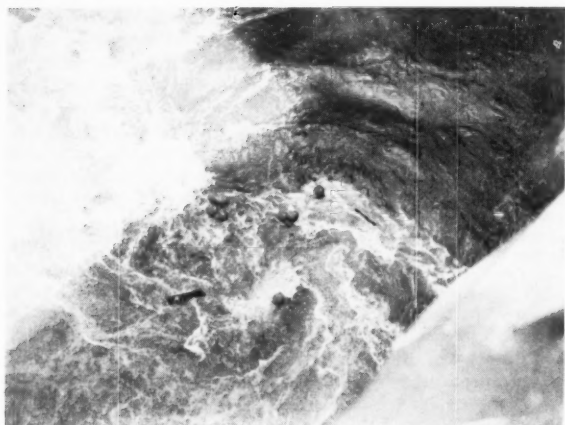
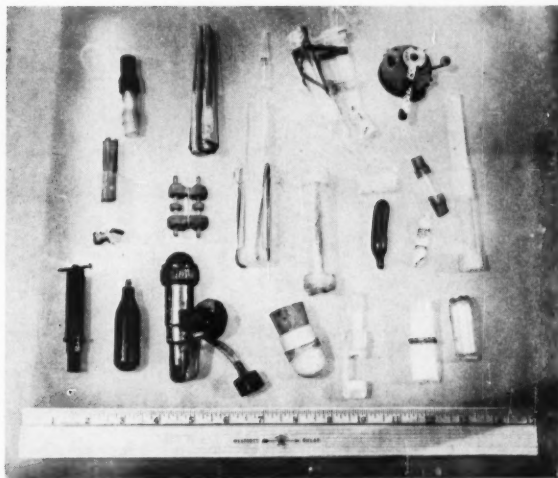
In 1947 it was found that fish could live for several days in the gossamer bags with no ill effects, providing that no tumbling or agitation took place. More was learned about the reactions of the fish to various conditions. At the Corps

of Engineers Bonneville Hydraulics Laboratory, located near (but not a part of) the dam, free swimming fish and specimens in gossamer bags were directed through an 8-inch venturi section. The section housed a near-perfect vacuum. Neither group of fish suffered any significant mortality in this test. This was surprising because the cavitation in the venturi caused vigorous shaking and a deafening noise. It appeared that the cavitation took place only in a ring around the jet of solid water, that the fish passed through well within the water and therefore were not subjected to the cavitation. A number of engineers have agreed with this view. In other tests, fish traveling at 46 feet per second in an 8-inch jet of water, were propelled at 90- and 45-degree angles of impact against a 3-foot-square steel baffle plate. The fish were unhurt. Apparently they could easily withstand such large shocks or the water somehow cushioned the impact.

## Field Tests

Moving finally to field tests, we sent several thousand fingerling salmon in gossamer bags through the turbines and spillways of Bonneville, McNary, White Salmon River, Elwa River, and McKenzie River dams. The bags imprisoning the fish were of soft nylon mesh, selected to give minimum protection to the fish. Two No. 16 extra-heavy, yellow balloons were sent with each fish to aid recovery. Among the materials tested to produce the necessary gas for inflation were: dry ice; aqueous acid and granular zinc;





**BALLOON PROBLEMS** Though generally successful the balloon and bag arrangement presented some problems. At upper left are examples of the units. Two nylon gossamer bags and two balloons form the left one. The right one has two balloons, one bag and a paper sack of sand to keep it temporarily submerged. Inside balloons were placed timers to release gas after the units slipped through the dam.

Timers developed in the search for an ideal one are shown in the upper right picture. Once in the water some balloon-bag assemblies inflated prematurely only to be swept uselessly into an eddy, lower left. The assemblies were well suited for passage through Kaplan turbines, but were efficiently shredded when put through Francis turbines, as seen at lower right.

compressed carbon dioxide in small cylinders; calcium carbide; Alka Seltzer; dry citric acid and dry sodium bicarbonate plus water; lithium hydride; calcium hydride; several aqueous acids and sodium hydroxide plus water; and powdered aluminum and sodium hydroxide plus water. Eventually calcium hydride was adopted because it produced a large volume of hydrogen gas and was reasonably priced. Further, it reacted with water to form whitewash, a relatively harmless and noncorrosive material.

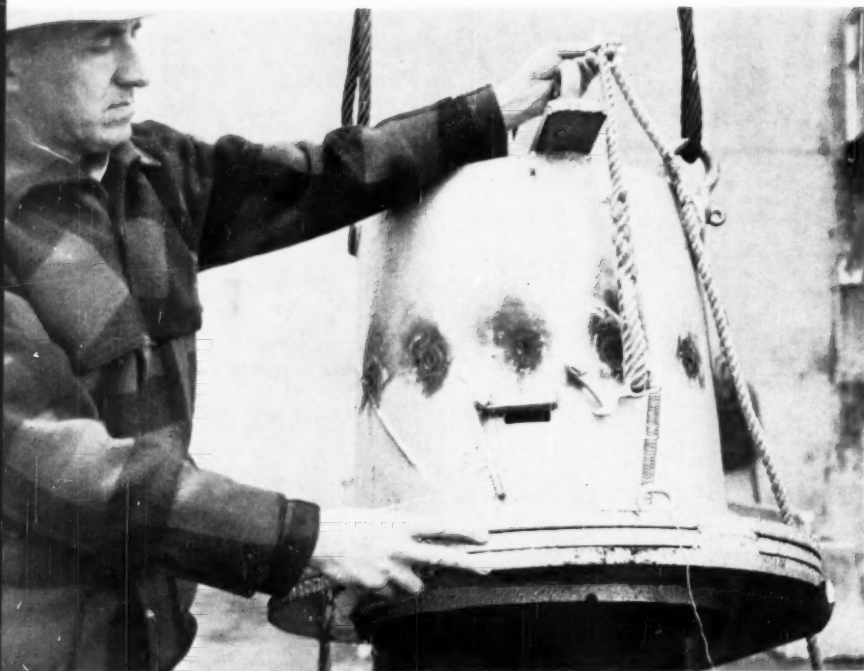
The greatest difficulty was in finding a device to cause the balloons to inflate at the proper time. Scores of inquiries to manufacturing concerns and individuals throughout the world did not succeed in locating a perfect timer. Such a device should combine several characteristics. It should be simple and absolutely reliable, quickly loaded, easily

adjustable, inexpensive, and light in weight. Gelatine capsules such as used in medicine proved to be the best. The size 000 capsule, about  $\frac{5}{16}$  inch in diameter and  $\frac{3}{4}$ -inch long, carries enough calcium hydride to inflate a balloon to a diameter of about 4 inches. Hundreds of these may be loaded in a reasonable time. They were improved by wrapping them with a layer of paper toweling and dipping them into molten polyethylene glycol E 400 (a waxlike but water-soluble solid). Still, they took too much time to inflate balloons. A better timer would have been a simple device about  $\frac{3}{4}$  inch in diameter, 3 to 4 inches long, and possibly made of plastic. A 3 to 7 minute delay was sought.

Shortly before the beginning of a field experiment, crew members in the laboratory placed the loaded capsule timers inside the balloons. At the scene of re-

lease, a cup of water was added to each of the two balloons. All air was squeezed from them; the necks were wrapped tightly with rubber bands and attached to the gossamer bag. Paper sacks filled with 1 or 2 cups of dry sand were attached by string to the bag. These served to submerge the unit and carry it into the turbine intake tube or under the spillway gate. In the turbulent water the paper sacks usually disintegrated, but in many cases hydraulic action was so mild that the sacks slipped through the turbines and spillway to be recovered intact.

Two boats retrieved the fish down the river. One was stationed 4 miles below the dam and the other 2 miles farther downstream. Portable radio transmitter sets aided tremendously in coordinating the two boats with the crew sending fish through the dam. In our early experi-



**PRESSURE CHAMBER** The author inspects a tank that was employed to field test fishes' reactions to pressure. The chamber was lowered to the bottom of the turbine intake tube in 75-80 feet of water. A headspace of compressed air aided pressurization. After 1-3 days the rope was pulled, opening the bottom lid, and the fish (in its gossamer bag) went through the turbine. Of 75 treated this way, only one died.

ments three small salmon were put in each bag. This resulted in some complications. When recovered, one fish might be dead, one might be injured and the third might be in good health. Statisticians objected to this procedure so in later experiments only one fingerling was placed in each bag.

Also in early trials, only 70 to 85 percent of the fish passing through the powerhouse turbines were recovered by the boatmen. Gradually better methods evolved in assembling the bags, balloons and timers, and the recovery increased to 90 percent. Faulty timers caused some of the balloon units to rise into the powerhouse draft tube stoplog slots, where they were recovered after the experiment. It was important to find every gossamer bag, because of the difficulty in accounting for the missing fish. Great effort was made to pick up 100 percent but the only time this was achieved was after the spillway dam ceased to discharge water into the north or spillway channel. By arrangement with the powerhouse operators and Bonneville Power Administration, U.S. Department of the Interior, certain gates were opened for short periods of time. After 100 fish were sent through the spillway gate, it was closed, allowing the recovery boats to enter the spillway stilling basin. Normally this is a very dangerous area. In the quiet water all of the

balloon units could be picked up. This brought the final average percentage of bag recovery up to 75 percent at the spillway.

When the spillway discharges 500,000 cubic feet of water per second, approximately 2,000,000 hp is being dissipated in the stilling basin by the two rows of pyramidal baffles located below the spillway gates. Such forces tend to separate the balloons from the gossamer bags. Many lone balloons were found below the spillway, so special efforts were made to tie the bag and balloons together. The best system was to make a girth hitch with the drawstring around the neck of a balloon. A strong rubber band was wrapped around the tightened girth hitch. This method did not succeed completely because even after it was adopted, single balloons were found below the dam.

### Timer Troubles

In first experiments the timers were not well developed. Many of the gelatine capsules ruptured when passing under the spillway gates, causing the water inside a balloon to react with the calcium hydride. The resulting hydrogen inflated the balloon prematurely. These units floated to the surface in what is called the "trough"—a furrow immediately below the spillway gates. Here the

fish were tossed about and soon died. Before the polyethylene glycol technique was in effect, approximately 30 to 40 percent of the balloons inflated prematurely and were lost to the experiment.

Another difficulty arose during the first attempt to use polyethylene glycol. Each gelatine capsule was wrapped with several layers of paper and then cooked for 10 to 20 minutes in molten carbowax. Only 27 percent of these test units were recovered. Later many of the balloons and gossamer bags were found 60 or 70 miles down the river, in the vicinity of St. Helens, Ore. Of course the fish were dead by this time. Thereafter the gelatine capsules were wrapped with only a single layer of toweling.

Use of the polyethylene glycol timer successfully prevented premature inflation—but usually delayed it too long. Commercial fishing boats miles below the dam found the balloons and recovered the fish and bags. A number of these were returned as long as a year later. Some were found near the ocean. Many fisherman did not return the data to Bonneville; instead they inflated the balloons to full size and tied them to the masts of their boats. Oregon and Washington State Fisheries biologists working on the lower river reported seeing many such vessels festooned with the large orbs. The wind drove many to river beaches where children discarded the fish and played with their new-found "beach balls." Others were washed onto isolated shores and discovered months later by friends of personnel at the dam.

The mortality of fish resulting from the passage through the Bonneville and McNary dam turbines, as indicated by the balloon technique, was statistically insignificant. About 2.5 percent of the fish died. At the Bonneville spillway mortality was higher, but it is believed that the gossamer bags and turbulence were the causes of the deaths, and not the passage underneath the spillway gates, nor the impact with the baffles.

It was not possible to determine the precise cause of death to all fish. Because their eyes had burst out, a few were believed to have been subjected to a vacuum phase or to cavitation. Many balloons also showed the affects of cavitation: small round disks of rubber were gone. Some of these holes were the size of 50-cent pieces, and some no larger than the head of a pin. By using two balloons, loss from cavitation was reduced.

The effects of sudden release of pressure on fish are known from experiments at the Corps of Engineers' Bonneville Hydraulic Laboratory. There, fish were held in a pressure chamber overnight, with a head space of compressed air to accustom them to pressure. In the morning the pressure was released at various rates of speed. If it were freed

as suddenly as 0.2 or 0.3 of a second, the fish were certain to suffer. Their eyes would burst out and air embolism would occur in the fins and in certain large blood vessels. To accustom the fish to pressure for field tests, a heavy steel chamber was designed. A gossamer bag containing a fish would be placed inside and the chamber lowered to the bottom of the turbine intake tube 75 or 80 feet below the surface. The fish was held there for 1 to 3 days before release through the turbines. A head space of compressed air was available to the fish to aid its pressurization. When actuated from the surface, a trip cord released a lid on the bottom of the chamber and the current carried the bag, fish and balloons through the turbines. Of the 75 fish put through the turbines this way, only one died.

### Adult Fish

The balloon technique has also been applied to mortality studies of adult fish. In 1953, a number of carp (in lieu of salmon) were run through the Bonneville spillway dam and recovered by use of balloons. However, attaching balloons to a violently struggling adult fish is not easily done. If the rubber units are attached to the mouth, the force of passing through the spillway tears the soft mouth tissues and separates the balloons from the fish. The fish is lost. In one experiment an attempt was made to tie the balloons to the serrated dorsal spine of the carp. So much difficulty was encountered that the experiment failed.

The balloon method has been successful where Kaplan turbines are installed. Bonneville, The Dalles, McNary, and Walmerville dams have this type. It also showed fair success in general exploratory studies in the Willamette Valley (though catching fish with a large net worked better). The method has not been successful where Francis turbines are in use—these wheels tear the balloons and bags, releasing the fish. Experiments were carried out at these dams, all of which have Francis turbines: Northwestern Power Dam on the Big White Salmon River near Underwood, Wash.; Leaburg and Walmerville dams on the McKenzie River in Oregon; and two Elwa River dams on the Olympic Peninsula in Washington.

When the balloon tests showed very little mortality at the McNary or Bonneville powerhouses, critics said that the gossamer bags protected the fish—though all the experiments had indicated that, if anything, the bags were harmful to the creatures. Presumably, the critics thought that the bags, being soft and resilient, acted as shock absorbers to protect the fish from shock. Experiments at the Bonneville Hydraulic Laboratory had shown that fingerling salmon were not injured by the shock

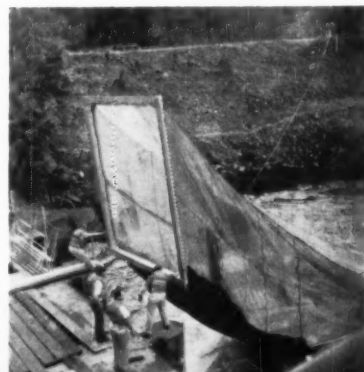
of being thrown swiftly against a steel plate.

In an attempt to prove decisively whether or not the bags protected the fish, Monte Montgomery of the Oregon Game Commission and I started looking for a large funnel net that would filter all the water from a single draft tube. Such a large net could also be used across a special spillway opening at Bonneville Dam. Personnel of the Oregon Game Commission, with whom I had worked on earlier experiments, obtained funds from the Columbia River Fisheries Development Program to construct a sizable funnel net. It was approximately 16 feet high by 14 feet wide at the upstream end, and 80 feet long. It was made of three layers. The interior mesh was  $\frac{1}{4}$ -inch nylon bobbinet; the next layer was  $\frac{1}{4}$ -inch Nyak netting; and the third, a strong circumferential and longitudinal reinforcement of Manila rope at frequent intervals. A live box attached to the downstream end of the net recovered tattooed fish sent through the turbines. The upstream end was attached to an aluminum angle frame that could be lowered onto the draft tube stoplog slots of the Leaburg and Walmerville dams. This net was tested successfully in August 1957 and September 1958 on the McKenzie River at Leaburg Dam.

**BIG NET** Another method for retrieving fish was this large net, seen here being installed at Leaburg Dam on the McKenzie River in Oregon. Tattooed fish were sent through the turbines, caught in the net, then held in a live box at the tip of the net, downstream.

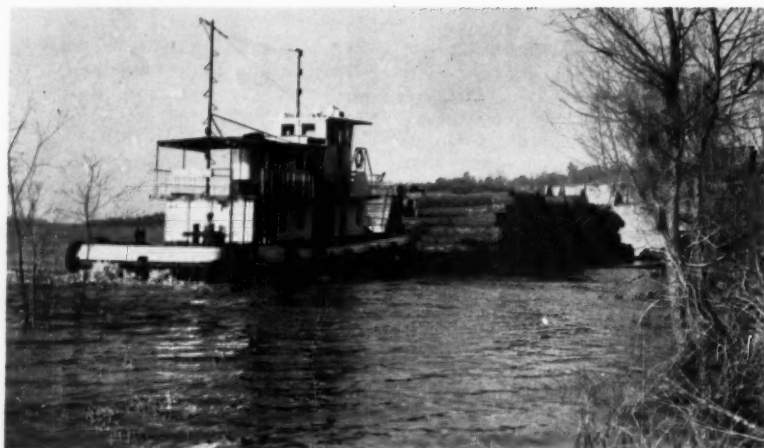
On September 15, 1958, the small net filtered about 1800 cubic feet of water per second. Subsequently it was enlarged to 105x20x22 feet. Tests in March, July and August 1959 at Stayton and Oregon City, Ore., gave more experience. Those who have worked with it are now confident that the larger net as originally planned, including improvements developed from experience, for use at Bonneville Dam would filter 10,000 or more cubic feet per second.

Even though only one net was available to filter the water from one of the two draft tubes at Walmerville and Leaburg, 75 to 80 percent of the tattooed fish were recovered (more water ran out the filtered tube than out the unfiltered one). At Stayton, 96 to 98 percent were regained. Tests with the funnel net, comparing the reactions of free swimming fish with those imprisoned in gossamer bags, are an important phase of our continuing research project.





# Oldest Sawmill Has



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**N**EAR Natchez, Miss., on the banks of the mighty Mississippi, an old sawmill observes a tradition that has stood for more than a century. As in times past, it continues to reap its harvest of lumber with the most up-to-date methods. The most recent improvement at the Learned Mill, as it is known, is an air-powered boom bucket that lifts logs and deposits them about the mill. Another advance is a pneumatically steered tugboat, *Miss Pearl*; and still another, a Filer & Stowell saw carriage.

Research has substantiated that the Learned property is the oldest sawmill in the United States operating on its original site. Perhaps one in South Carolina is older by a few months or even a year, but it has been moved to various locations throughout the state. The Learned Mill represents 131 years—but only three generations—of family ownership. Three years after the mill was built in 1825, it was acquired by a Scot, one Andrew Brown. He was the progenitor of the family that still owns the mill. His own daughter Elizabeth married his stepson Rufus Learned. The present owner, Andrew Brown Learned, is their son, now aged 90. He still visits the mill several times each week to see how work

progresses. His grandson, H. B. Peabody, is the general manager.

There is, of course, little similarity between the present equipment at the mill and that which first reduced tall trees to finished lumber. When the original sawmill was built, its first boiler came from a salvaged steamboat. Its one sash saw cut only cypress logs. Circular saws were installed about 1858—in time for Union troops to get 2 full years use from them. The first band saws were set humming in 1879 when this type of saw was an innovation anywhere in the land.

After Rufus Learned took control and paid off \$175,000 in Civil War debts, he began to look to the future and to give the mill a sound financial foundation. Today the Learned holdings include large interests in a bank, an ice plant and much additional property in town. Also, oil wells have come in on some of the company-owned timberlands. Consequently, the old mill can be considered something of a hobby rather than a full-time business for owner Learned.

One of the foresighted moves by the family was the purchase of timberlands bordering the bank of the Mississippi River. The land amounts to some 40,000 acres. To maintain an adequate



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# New Ideas

Clee Woods

lumber supply, trees are cut systematically. None smaller than 16 inches in diameter is felled. Every 10 or 15 years the same ground is recut, for trees mature rapidly in the warm climate, often adding an inch of diameter a year.

At one time it was customary to purchase timberland up river. Logs were rafted downstream and diverted into a short canal leading from the Mississippi to the mill. There they were pulled by cable directly from the water to the saw skidway. Today, the timber is brought in by barge by the Learned Mill's own marine equipment. There are two derrick barges, three log barges and *Miss Pearl*. She can be seen in *Picture No. 1*, pushing her log-laden barge into the sawmill port. She is a deluxe pusher-type tug that is more a pleasure craft than a conventional tugboat. She has two private cabins and a modern all-electric galley. To steer her, two short levers are moved instead of the usual pilot wheel. These levers pneumatically regulate the rudder to keep the tug on course through the strong river currents. Now and then one hears a swish as the tug sends its barges dodging around a floating tree, or past a great packet of barges lashed together. The air for the steering mecha-

nism is supplied by two compressors.

It takes about a day and a half to load the Learned barge with 125,000 board feet of cottonwood, willow, ash, poplar, pecan or chinaberry logs. After they are brought to the mill, the derrick barges go into action. They swing the logs from the cargo barges into little cars positioned on standard-gauge tracks. The cars carry the logs up to the mill. The air-powered boom bucket, a close-up of which is shown in *Picture No. 2*, was installed in 1958. It picks up the logs, as illustrated in *Picture No. 3*, moving them to stockpiles. From his perch in the second story of the mill, the boom manipulator observes the entire unloading operation. He can see the barge derrick lifting the logs to the rail cars. The operator maneuvers the air-powered bucket down to the topmost two or three logs. The claws, powered by a husky air cylinder, close around them, then are swung to a log pile on the skidway.

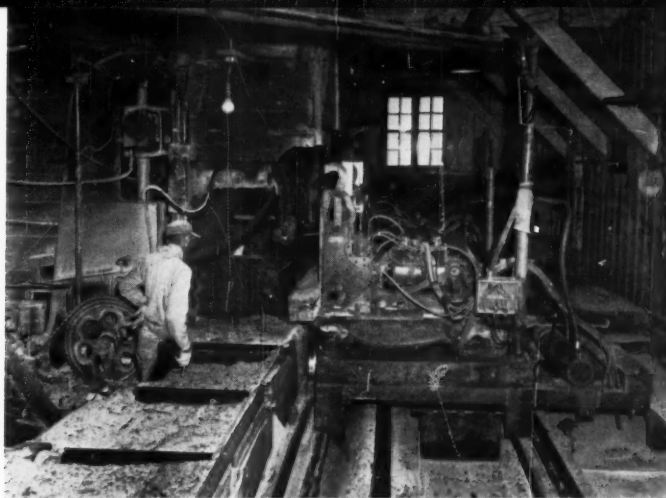
Compressed air for the bucket passes through metal pipe and rubber hose from the compressor to the derrick. It then goes 40 feet up the boom through  $\frac{3}{4}$ -inch rubber hose to the bucket's air cylinder. The air-cooled compressor is seen in *Picture No. 4*. It is an Ingersoll-

Rand Type 30, Model 20T2A, and is located in the second story of the mill near the derrick operator's post.

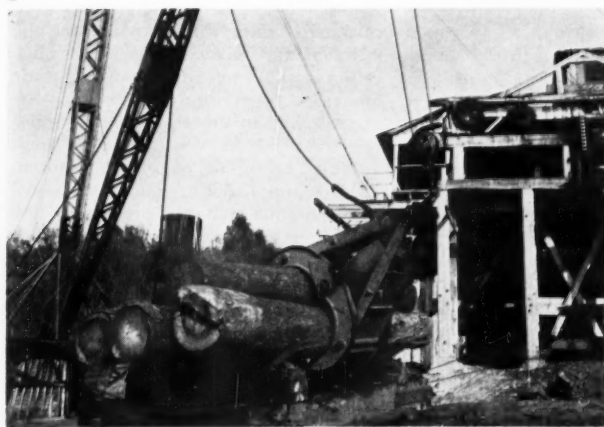
The bucket has reduced labor costs as well as providing a safer operation at Learned Mill. It has replaced the practice of using two men called tong hookers. One worked at each end of a log. The tong hookers grabbed the large tongs as they swung by, suspended from a boom. Then each drove his tong end into the end of the log and the log was hoisted away. This practice was tricky and not always safe.

A cable pulls the cars from the cargo barges to the mill. The bucket picking up the logs is shown in *Picture No. 5*. The logs then are dropped to the skidway, *Picture No. 6*, about 30 feet high. Chain belts feed them into the saw carriage. The carriage, *Picture No. 7*, was made by Filer & Stowell. Its three blocks are set by compressed air from a second compressor located in the mill, this one being on the ground floor. The band saw in operation cuts about 7,500,000 board feet a year, mostly prime lumber.

Andrew Brown Learned, viewing his sawmill from his mansion on Natchez Bluff, has a right to be proud of his hobby.



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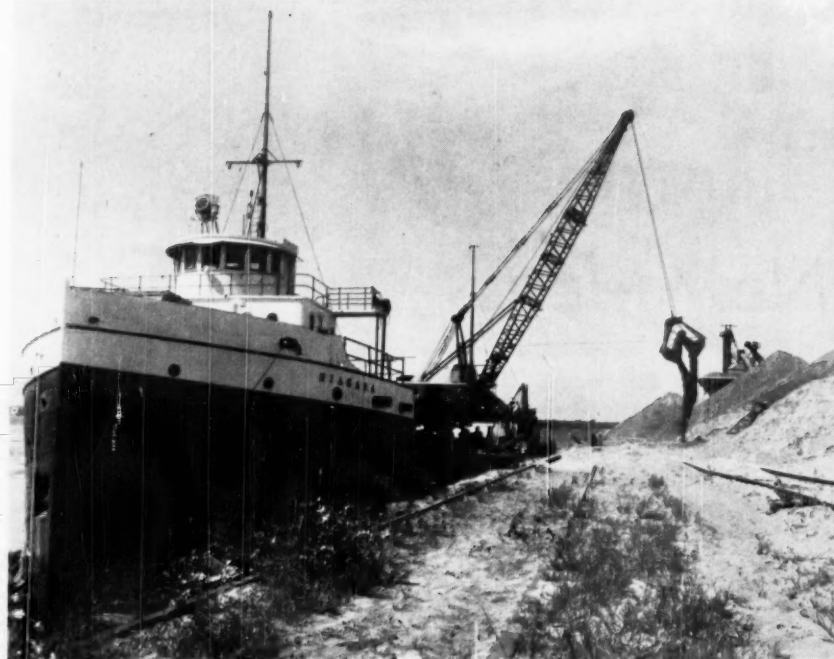


6



## FROM STEAM TO AIR

Erie Sand Steamship Company  
Converts Veteran  
Sand Boat  
To Air Power



Walter Rudolph

**BOAT AT WORK** Erie Sand Steamship's converted "Niagara" demonstrates the versatility of its "live-boom" crane by unloading at a dockside where no sand handling facilities are available. The big boom is 70 feet in length and swings a 2 1/2-yard clamshell. The unit is a diesel-powered Bucyrus-Erie 51-B crane mounted amidships.

**S**PEEDING between sand-pumping grounds and dockside unloading points on the Great Lakes is a veteran boat—half-a-century old—that shows new speed and smartness. She is the *Niagara*, a vessel that was practically obsolete but which has been given up-to-the-minute efficiency by conversion to diesel-air from steam. She is owned and operated by Erie Sand Steamship Company, Erie, Pa.

The term diesel air has essentially the same connotation as diesel-electric, that is, the diesel engine drives an air compressor and the compressed air thereby generated drives a number of small steam engines or auxiliaries. It does not mean, however, that air drives the main propulsion shaft, that being a job done directly by diesel power.

The firm handles its own conversion work under the direction of Captain Jos. S. St. John, company owner, and George Griswold, chief engineer, along with two master mechanics. They set to work on the *Niagara* last spring after obtaining her from Gravel Products, Buffalo, N. Y. *Niagara* followed the firm's sand boat *Lakewood* to the conversion dock. Griswold explains that the firm has found diesel-air operation the most practical form of sand-boat operation for his firm. Basing his remark on more than a year's experience since the *Lakewood* was converted, he finds diesel-

air operation even more efficient than diesel-electric, which was also built into one vessel several years ago. Erie Sand requires boats that can make repeated trips to sand-pumping grounds at the lowest operating cost per trip.

As far as could be ascertained, the *Niagara* first plied Great Lakes waters shortly after the turn of the century. She was built by Bay City Shipbuilding and is a 225-foot vessel with a 48-foot beam. Her old propulsion system was a 900-hp triple-expansion reciprocating steam engine. This was removed along with one of the boilers, the other being converted into the boat's air receiver. The main propulsion unit is now a 1250-hp Cleveland General Motors diesel with a Wichita air clutch and Falk 4.3:1 reduction gears.

*Niagara* has a 111×74-inch wheel and an unladen cruising speed of 11.8 mph. She can make about 11 mph when carrying a full load—about 1700 cubic yards—of wet sand. One of the more profitable features of the converted vessel and perhaps a "first" in Lake waters, is a Bucyrus-Erie 51-B "live boom" crane mounted amidships. Its 70-foot boom, equipped with a 2 1/2-yard clamshell, enables the *Niagara* to unload practically anywhere that she can get close to shore, without the necessity of dockside unloading equipment. The crane is powered by a Caterpillar D-337 engine.

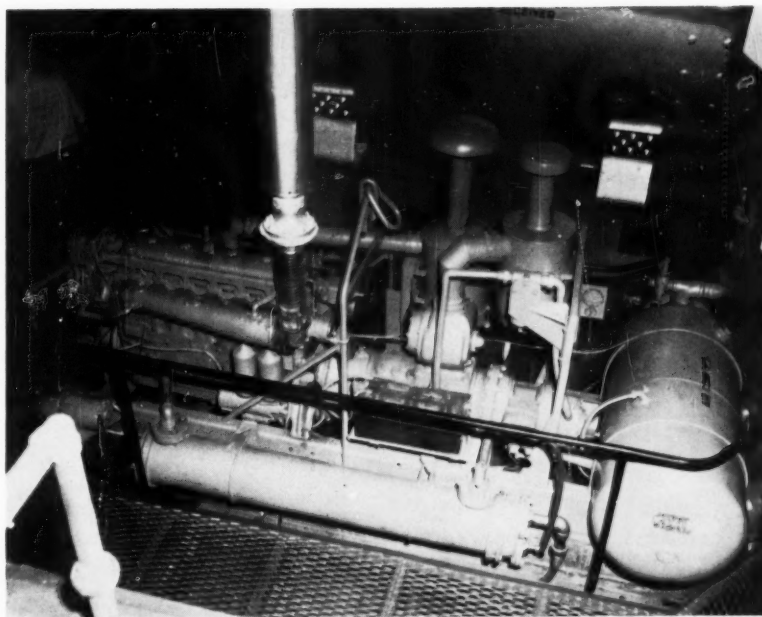
Two more diesel engines power Ingersoll-Rand Gyro-Flo rotary compressors, each of 600-cfm capacity. One is the main compressor and is permanently installed in the old boiler room. It is a marine-fitted unit. The other, a standby, is a mobile compressor and is fixed forward on the *Niagara*'s deck and tied into the air system. The distribution network is made up of the old steam lines that served a dozen or so auxiliary pumps, winches and the like.

Each of the old auxiliary steam work engines was also converted to air operation. This was done throughout the vessel at a cost less than might have been entailed had even one of the hoist engines, for example, been replaced by an electric driver. The old engines were converted rather simply by reboring the cylinders and replacing pistons. Lubrication methods were also changed for air operation, four Norgren lubricators being installed in the piping net at intervals. Several Denver lubricators were also used on specific engines as required.

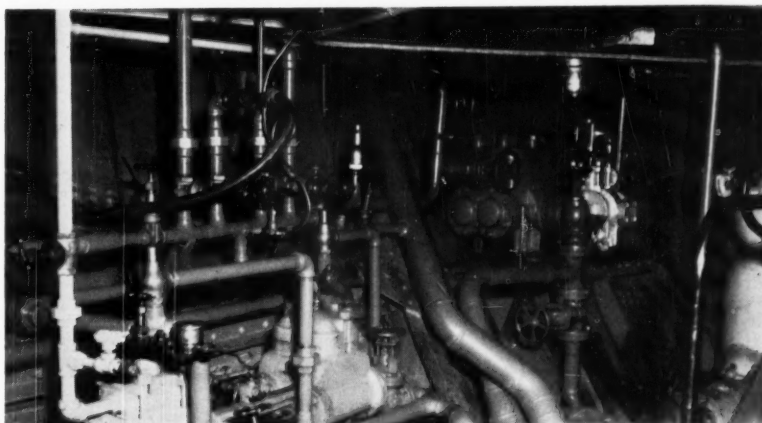
Air is supplied throughout the vessel at a nominal 120-psig pressure. The main users are hose hoist winches, mooring winches, anchor windlass, standby water pump for sand pump glands, steering gear equipment, bilge pump, ballast pump, sanitary pump, fire pump, etc. Several of these units have protective standby electric drives as well, power for



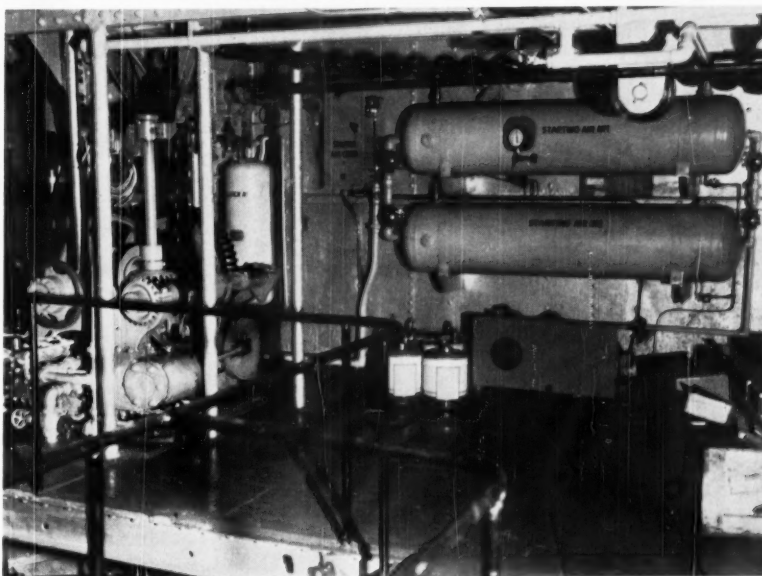
**AIR SUPPLY** This marine-rigged Ingersoll-Rand Gyro-Flo compressor serves as the main air supply for the converted "Niagara." Delivering 600-cfm at a nominal ships pressure of 120 psig, the unit is driven by a General Motors 671 diesel. In the foreground is the unit's heat exchanger; at the right, the receiver-separator; and in the background, the one-time boiler, now air receiver.



**AIR-DRIVE PUMPS** Shown here are the sanitary and bilge pumps which were converted to air-power by the simple reboring of the steam cylinders that once powered them. The conversion cost considerably less than if the pumps, as well as many of "Niagara's" winches, had been converted to electric drive.



**STARTING AIR** Just below the starting-air storage tanks, and shielded by its belt guard, is shown a small electrically driven Ingersoll-Rand compressor furnishing starting air to spin the main propulsion diesel—a General Motors 12-576 engine. At the left can be seen the storage tank serving the Wichita air clutch on the main propulsion unit. It is partially obscured by the complex linkages of the vessel's steering apparatus, which itself was converted from steam drive to air power.





**CONTROLS AND STANDBY** The picture above (left) shows the wheelhouse from which Capt. M. S. Brewer runs his vessel. Virtually all of the boat's many diesel engines can be started by remote control, many of them being equipped with Ingersoll-Rand air-starting motors. At the right is the main propulsion link, the left-hand unit being the Wichita air



clutch which gives exceptional control of the boat's movements on the sand-pumping grounds. Below is the "Niagara's" second compressor—an Ingersoll-Rand 600 Gyro-Flo (less running gear) which is mounted on deck. The secondary unit is used when starting the big sand pumps and as a standby. In the foreground is a converted winch.

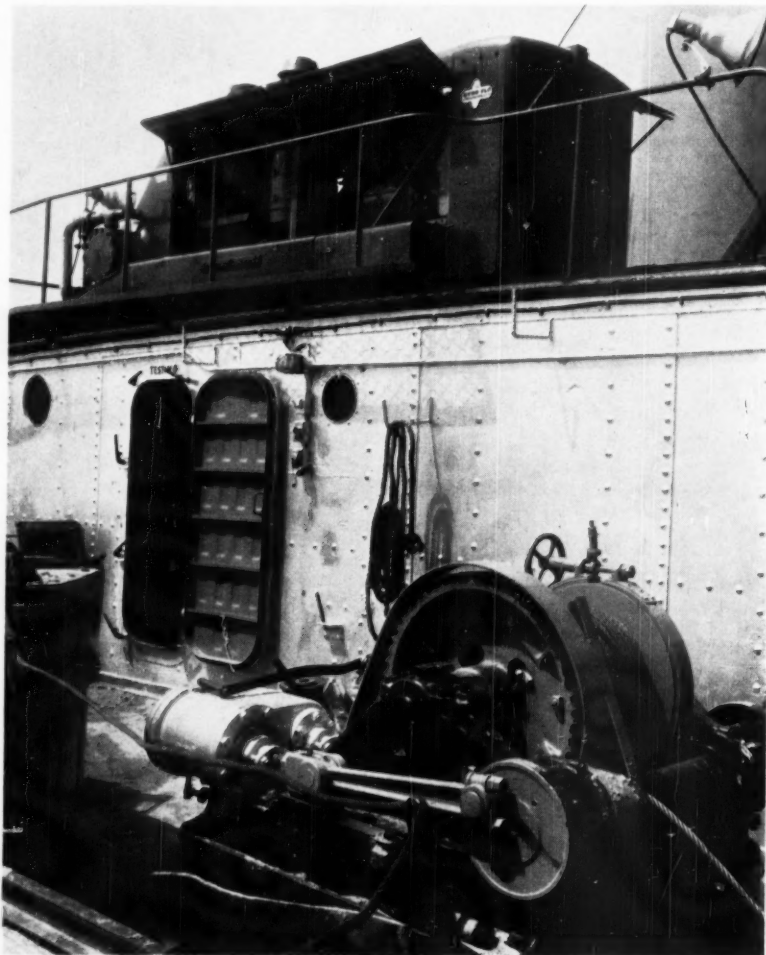
them and lighting being furnished by a pair of auxiliary ac generator sets of 60-kw capacity. Under normal conditions, one generator is in use.

Compressed air power puts the ship's operation under fingertip control, according to Capt. M. S. Brewer. The air starting equipment, for example, is a great convenience. Not only is the main driver started with air, but many of the seven smaller diesel auxiliaries throughout the ship are equipped with Ingersoll-Rand air-starting motors.

The Wichita air clutch, a comparatively new device on commercial vessels in the Great Lakes, makes the *Niagara* especially efficient at her job of sand dredging. Air power gives Captain Brewer precise remote control of the boats movements on the pumping grounds. Her speed and reversing ability are vital in coordinating movements with the actual material-gathering or sand-pumping. With air power the entire operation is efficiently run.

Air performs yet another important task. When starting the huge sand pumps—there are two of them—an air siphon arrangement is used. Both compressors are required for the start-up.

At the time this article was written, the *Niagara* was being used to place sand into steel cells that form the outline of a new pier being built at her home port in Erie, in Misery Bay. The opening of the St. Lawrence Seaway to the Lakes is expected to stimulate considerable construction work in all of the ports, thus keeping *Niagara* and her sisters busy. It is a rather distinguished role for the once obsolete boat to play.



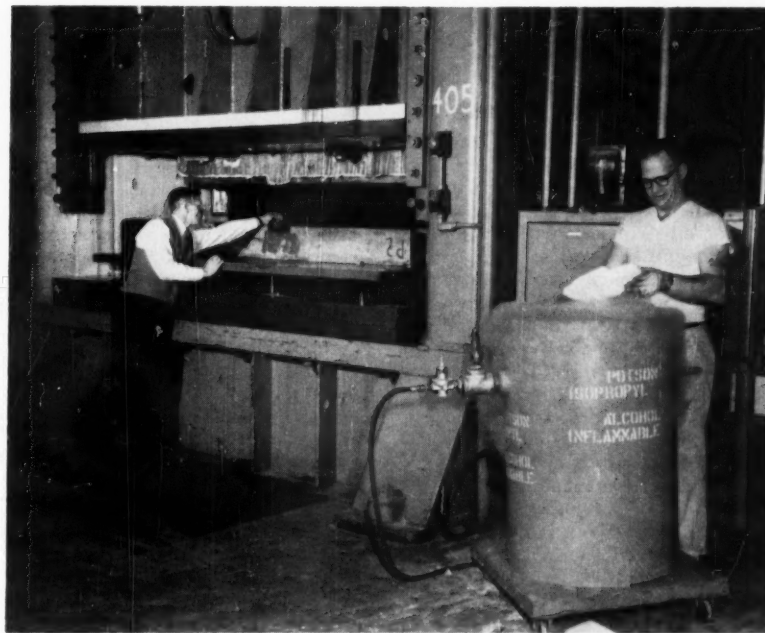
## Fast Freeze for Hot Parts

**W**ITH the invention of a new die-quenching process, Ryan Aeronautical Company has achieved a breakthrough in the rapid forming of tough heat-resistant alloys. Precise shapes and degrees of hardness are possible with the process, which cuts the time required for a cooling cycle from 10 minutes to less than a minute. Just as important, it keeps the die in which the metal is chilled at a low temperature, permitting its constant use. Formerly, the cooling process would have to be stopped frequently, for the die would absorb so much heat from the red-hot metal that it would lose its quenching ability.

The invention has two principal components: the die itself and a portable cooling tank. The die on which the metal is finish-formed is cast with a 3-inch iron pipe running longitudinally through its center. Holes are drilled through the face and sides of the die into the pipe. The pipe is threaded on each end so that it can be attached to tubes connected to the portable cooling tank. The tank supplies 60-psig-pressure dry air at subzero temperatures.

Before the die is put into operation, both it and its companion punch are cold-soaked until both parts are at least 40° F. During operation, the frigid air blasting through the die keeps it cold, and as the air escapes through the holes drilled into the face of the die, it chills or quenches the workpiece nearly ten times as fast as the previous method.

The second segment of the equipment—the portable cooling tank—is a barrel approximately 3 feet high and 26 inches in diameter. It is mounted on casters. Inside the barrel is an airtight tank approximately 14 inches in diameter and 22 inches high. A 3-inch-diameter pipe runs through the side of the barrel into the tank, and is within 2 inches of the bottom of the tank. This is an air intake pipe and is equipped with a con-



**PATH OF AIR** Cold air comes into the die from a tank filled with dry ice and alcohol, and is played onto the workpiece through the holes pointed out by the engineer at left.

necting tee for air intake from plant air lines, a pressure regulator, and a safety valve. On the opposite side is the air discharge pipe. It extends from the top of the tank through the barrel and is connected to the quenching die. The inner tank through which the air flows is filled with dry ice, and the space between the tank and the barrel is filled with isopropyl alcohol and dry ice.

Just as important as the quick chilling, is the time saved and the accuracy gained through a revision of the die manufacturing method. Before the new system was installed, both the die and the punch were made of Kirksite from reference patterns. The punch was then laboriously and painstakingly matched to the die. In making a particular punch, the reference patterns might involve 30 man-hours of work; the molding and casting of the punch, 6 man-hours; and the matching-up process, another 60 man-hours.

With the new method, a simple lead punch is used. The finished die is used as the mold, and the lead is poured into the die. This assures complete and accurate matching, and since the die doesn't heat during the quenching process, the lead punch doesn't melt during use.

The cooling cycle is required in many of the alloys used in jet aircraft. As an example, Ryan uses tons of 17-7 PH stainless steel in building the engine pods and pylons for the Douglas DC-8 Jetliner. Parts are first formed in the annealed, or soft, condition. A heat-treating process—known as the transformation cycle—then hardens and embrittles the soft material. A critical part of the transformation cycle is the time during which the metal is brought from an oven, where it has been held at 700° F, cooled in a finishing die to at least 80° F, and then placed in a refrigerator. No more than 15 minutes are allowed to move the part from the oven, through the die, and into the refrigerator.

Before introduction of the new process, a major stumbling block was the die-quenching period. In continuous operation, the die would soon be heated to a temperature at which it was not possible to chill the part in the time allowed. Work came to a standstill until the die had cooled enough to permit operations to resume. With the new hollow-core dies and the portable cooling tank, the dies are kept cold, the part is chilled in about 1 minute, and the press remains in production as long as required.



**DIE SKETCH** Shown is a typical die in place. The upper punch, made of lead, is protected from fierce heat of the workpiece by blasts of frigid compressed air that chills the piece to room temperature in less than 1 minute.





# This and That

## Energy By Isotopes Or Ankles?

That seemingly ubiquitous but as yet nonexistent chap, Man In Space, will need an auxiliary power supply to set humming the gadgets in his void vehicle. This creates a weight and volume problem and two ideas for solving the problem are poles apart: one is the use of miniature nuclear reactors; the second is that man may have to (partially at least) pedal his own space ship.

A lightweight, high-temperature nuclear reactor has been test operated at design power and temperature. Designated SNAP Experimental Reactor, it is comparable in size to a 5-gallon can. The unit weighs about 220 pounds without shielding and is fueled with enriched uranium. It was built for the Atomic Energy Commission by Atomics International, a division of North American

Aviation, Inc., and is located at an AEC facility near Los Angeles, Calif. In actual operation, heat from the reactor would be transferred by a liquid sodium coolant to a boiler containing mercury. Mercury vapor would drive a miniature turbine. Such a conversion system has been successfully operated with an electrical (instead of a nuclear) heat source. The unit takes its name from an AEC program called Systems for Nuclear Auxiliary Power. Two basic concepts are being followed. As well as the turbine principle, studies are being made to use heat from a radioactive isotope to operate electrical power conversion equipment.

At the other end of the scale are the suggestions made by Ezra S. Krendel, head of the engineering psychology branch of Philadelphia's Franklin Institute. In a paper entitled Man-Gener-

ated Power, he points out that the space man may not be completely a pusher of buttons. In order to save space and weight, the passenger may have to crank or pedal to supply power for the rocket ship. Krendel discusses various methods for determining the most efficient way to design a machine for hand or foot operation. One valuable source of experimental information, Krendel notes, is a group of papers written in German in the 1920's and '30's that tell how to produce a flying bicycle. To go back a bit farther, a similar device, called an ornithopter, was sketched by Leonardo da Vinci some 450 years ago.

★ ★ ★

## Mobile Air Leak Detector

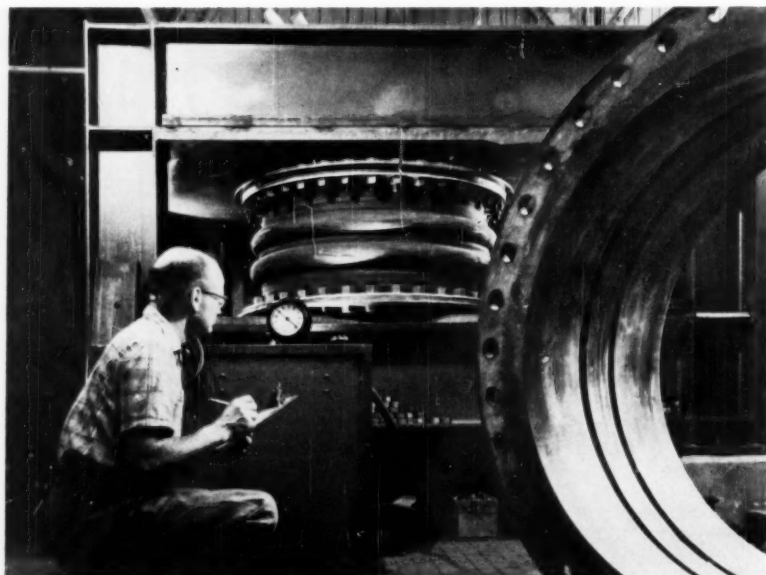
A roving leak detector, patrolling 250 miles of vacuum gas pipeline, has achieved a 50-percent savings in sampling time at the Salt Creek Gasoline Plant of Pan American Petroleum Corporation, Midwest, Wyo. The pipeline collects natural gas under vacuum from approximately 800 wells for processing at the plant. Air leakage into the system not only loads the compression facilities, but also causes problems in regulating the fuel supply to internal combustion engines using the natural gas. Excessive quantities of air in the system may even result in plant shutdown because of the inability of the engine-compressors to operate on the lean fuel supply. The detector plays a key role in ferreting out the entry of air anywhere along the piping network. The roving system combines a small air compressor, mounted on the motor of a 1½-ton truck, with a Mine Safety Appliances Company portable oxygen indicator. The compressor is driven by a belt from the fan pulley of the truck motor, and pulls a sample of gas from the vacuum line and discharges it through the portable oxygen indicator. The amount of oxygen in the gas sample is read directly from an analyzer. According to Salt Creek personnel, the new detection system has cut in half the time required to locate air leaks, and has thereby contributed to a smoother plant operation.

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## Educational Pneumatic Playthings

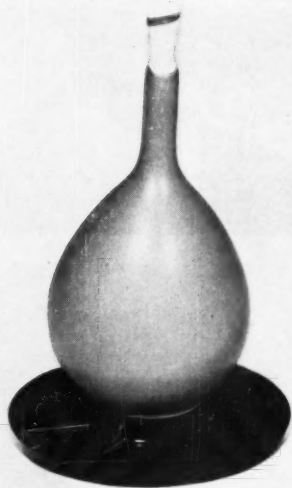
Illustrated here is an air puck being sold by Edmund Scientific Company. At first glance it is but a child's plaything, but in reality, it demonstrates an important principle of compressed air technology—the same principle that is used in air-supported vehicles, such as Ford's Glideair (see *Compressed Air Magazine*, June 1958), and air-supported conveying platforms. The low-friction puck has a smooth circular bottom with

## VITON FOR SUBMARINES



One of a series of Viton-lined neoprene expansion joints is hydrostatically tested at The Garlock Packing Company, Palmyra, N. Y. First of the type ever manufactured, the double-arch joints are for use in U. S. Navy nuclear submarines. They are to be located in exhaust lines carrying turbine steam to condensers. Viton was specified because of its freedom from chlorine ions. The carcass of the joints is fabricated of neoprene; the joints are asbestos reinforced with internal steel body rings. A special binding process was developed by Garlock to adhere Viton to the carcass.

a tiny orifice in the center. Attached above the puck is a balloon, which, when inflated and sealed at the top, allows the trapped air to escape through the orifice. This lifts the puck so that it can



be easily pushed long distances with a minimum of force. The air acts as a lubricant and almost completely eliminates friction. This device, and a more expensive model that utilizes a carbon dioxide cartridge in place of the balloon, makes an excellent teaching aid. Elastic and in-elastic collision, momentum and conservation of momentum, are just some of the experiments that can be demonstrated in the field of physics.

Another pneumatic "toy" manufactured by the company is a 2-stage rocket of the type used by government-sponsored science teaching systems to demonstrate the principles of jet rockets. The rocket is partially filled with water, the balance of the space being filled with compressed air from a pump. When a release is pressed, the first stage soars to 200-300 feet, whereafter the second stage continues the trip. The kit contains a first and second stage rocket, satellite fuel (water) supply tank, and an air injection pump, and sells for less than \$3.

★ ★ ★

#### Automatic Servings For Cattle

More than 2 billion tons of materials are handled on American livestock farms annually and require an estimated 22,000,000-hp hours. Mechanization and automation of this job is one of the goals for more than 5000 agricultural engineers in the country. Emphasis is being placed in this field of engineering as pressure mounts for help from agricultural experiment stations in increasing efficiency in farm production and operation. Colorado State Uni-

versity's agricultural engineers, for example, are testing the possibilities of air transportation of feeds and grains. What they have in mind is a king-sized vacuum arrangement that will pull grain through a line from feed bins to points of use, thereby simplifying the mechanical equipment required. An increased flexibility is also anticipated. The engineers believe that air conveying can easily be incorporated into feed handling systems, and their research, which has been temporarily halted, may provide the information needed to produce the most effective design of such a pneumatic system.

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#### New Inco Steels

A remarkable family of very high strength nickel alloy steels has been invented in the Research Laboratories of The International Nickel Company, Inc. Nominally identified as 25-percent nickel steels, these alloys achieve unique properties by simply air cooling from the heat-treating temperatures. Yield strengths in excess of 250,000 pounds per square inch with 6- to 10-percent elongation and above 20-percent reduction of area are obtainable in section thicknesses

where such high strength properties were not heretofore attained. It has been reported that in some cases, yield strengths in excess of 290,000 pounds per square inch have been achieved. Maximum hardness in excess of 67 Rockwell C has been obtained. After a simple annealing treatment, which consists merely of air cooling from solution temperature, many of these new steels also possess excellent cold-forming characteristics.

The fact that the high strength properties are obtained without liquid quenching means that intricate parts can be fabricated to close tolerances while the steel is in its soft annealed condition and can be hardened to these high strength levels without appreciable distortion. This factor, together with the high order of mechanical properties attainable, should make the 25-percent nickel steels of particular interest for applications in aircraft and missiles and for high strength wear-resisting precision parts such as bearings. Another unusual feature of the steels is that they are weldable without preheat in the hardened condition. This, together with the extremely high strength properties, which are not limited to thin sections, is expected to lead to important applications in heavy-wall pressure vessels and in heavy defense equipment.

## Compressed Air Oddities

ONE EFFECT of the invention of pneumatic tubes was to deprive small boys of one type of employment. In large department stores, the lads served as "cash boys," their duty being to "run" change from the cashier to salemen. This fact was recalled last spring by Thomas J. McLees on the occasion of his retirement from Stern's Department Store in New York after 75 years of service. He started on May 5, 1884 as a 12-year-old cash carrier. Tubes were substituted for the service soon afterward.

AND, speaking of pneumatic tubes, one of them fouled up some of the reporting of sales of securities on the New York Stock Exchange last year. One of the services performed by the building's extensive tube system is to deliver paper slips carrying notation of each sale from the floor of the Exchange where the sales take place to the transmitting room where the record is transferred to ticker tape and sent out by telegraph to brokerage offices throughout the nation.

On the day concerned, a tube leading

from Trading Post No. 2 jammed and for several minutes no quotations appeared on Sperry Rand Corporation, which was the most traded stock that day. When the jam was cleared, the tube disgorged so many sales memos that it required 20 1/2 inches of ticker tape to print them. The string covered 40 sales, involving 11,400 shares.

THE JULY 1909 issue of *Compressed Air Magazine* carried this note: "The Ingersoll-Rand Company has recently sold an air compressor to supply air, as mentioned in the order, 'for putting trousers on sausages.'"

COMPRESSED AIR haulage was once common in coal mines and high-pressure air lines were run from compressor plants on the outside to charging stations within the mines. In Alberta, before 1920, one such mine caught fire. The compressor was stopped, a large pump was connected to the line and water was pumped through it and the fire extinguished.



**VICTOR G. HINDMARSH** A builder, not just of work projects, but of younger men who will build the even larger projects of tomorrow. . . . For his own well-recognized accomplishments and for those of the men he has inspired and trained, the Beavers present this tribute.



**ALGOT F. JOHNSON** As a leader in the construction industry he has shown great imagination and tenacity of purpose. He is equally active in the civic affairs of his community. As an individual he has always maintained an abiding interest in the welfare of his fellow man.



**T. J. RILEY** He is typical of those devoted men who serve the construction industry, the Beavers are privileged to his years of service to the industry and for the credit he has brought to that industry, the Beavers are privileged to honor this outstanding authority on construction equipment.



**WALTER SCOTT** His warm personality and understanding have earned him respect and friendship throughout the construction industry. In addition, his well-earned reputation as one of the most astute and capable engineers and estimators in the industry make him a worthy recipient of this award.



**W. J. LEEN** The type of construction man who has made the Corps of Engineers one of the most respected agencies of our government. This dedicated Federal employee is known throughout the West as an able leader and a top-flight engineer . . . of exceptional management abilities.



**GENERAL RAYMOND A. WHEELER** The special award winner is one of that rare breed of men who has combined a military and engineering career to the honor of each. It is fitting that the Beavers honor a man so renowned, both at home and abroad for his military and civilian accomplishments.

## GOLDEN BEAVERS AWARDS FOR SIX

GOLDEN BEAVERS Awards for 1960 were awarded to six outstanding members of the construction industry for service in five different categories. The Beavers, an organization of men and companies in the heavy engineering construction industry met January 21 in Los Angeles for their Fifth Annual Meeting and Awards Dinner. The 1960 Awardees are: in the management category, Algot F. Johnson, Al Johnson Construction Company, and Walter Scott, Peter Kiewit Sons' Company; in supervision, Victor G. Hindmarsh, Bechtel Corporation; in Engineering, W. J. Leen, U. S. Army Corp of Engineers; in supply, Tim J. Riley, Ingersoll-Rand Company; and, for the special award, Raymond A. Wheeler, Lt. General, U. S. Army, (ret.). The citations for each of the men are included, in part, in the picture captions.



# EDITORIAL

## Birthday for Hoover Dam

**H**OOVER DAM is this year celebrating its twenty-fifth birthday. The massive structure, still the highest dam in the Western Hemisphere, was dedicated September 30, 1935, just 5 years after the President whose name it bears signed the Appropriation Act providing funds to initiate construction. Actually operation of the structure was begun 25 years ago this month for on February 1, 1935, the diversion tunnels were plugged and water storage started.

Since that date, flood control on the reaches of the Colorado River below the dam has been complete. In all but 2 years since storage started, inflows into Lake Mead have reached 40,000 cfs at least once during each year. That quantity of water prior to the dam's construction was generally considered as being damaging to property and dangerous to lives. In seven of the intervening years, inflows exceeded 100,000 cfs, a flood condition that would have caused widespread damage to a number of cities and farming areas along the Colorado.

Hoover Dam was constructed by Six Companies, Inc., under terms of a \$49 million labor contract. The over-all cost of the project is expected to reach \$175 million by the time the last generators are installed. Besides paying for itself many times over in lives and property, the big dam is doing all right from a monetary standpoint, too. Since 1935 there has never been a shortage of water for industrial, domestic or farm irrigation purposes in the area served. In 1958 alone, lands irrigated from Lake Mead produced crops valued at more than \$175 million; since 1935, crops valued at about \$2,250 million have been harvested. Gross revenue from operation of the dam and its appurtenant works has amounted to \$182.5 million or about \$6,500,000 more than cost. Eventually all but about \$3.5 million will be returned to the Federal Treasury, most of it with 3 percent interest. The \$3.5 million not chargeable was spent for nonproject costs, and about \$25 million that was spent for flood control works will not bear interest until 1987.

**E**LECTRICAL energy from the Hoover powerhouse has been the keystone of the financial success of the dam. The giant generators have spun out more than 96 billion kwh of energy—enough to supply all of the homes in the United States, in cities and on farms, for half a year. Annually some 6 billion kwh are transmitted from Hoover Dam and other powerhouses on the river below that were made possible by the mighty structure. Now that the last of the Hoover generators are going into place, that single installation will have a total capacity of 1,344,800 kw.

**S**ILTING of the Hoover Dam reservoir was a shibboleth of the days preceeding its construction. Estimates of how long it would take the waters of the Colorado to deposit enough silt in the reser-

voir to render it useless varied from 25 to 300 years. The latter estimate has proved to be the more nearly correct. When completed the reservoir capacity was about 31 million acre feet. Today it stands at an estimated 29 million acre feet and should be good for another 300 years, even without current silt control projects underway upstream that will substantially reduce current rates of deposition.

**C**OMPRESSED air built the Hoover Dam, perhaps more than any other power. Among the first items of equipment to be floated downstream and landed at the site were portable compressors. By the time the road from the rim of the canyon down to the river was completed, 18 units were on hand to supply air for rock drills. When a base of operations was finally whittled from the canyon floor, the first major equipment installation was a trio of compressor plants made up of eleven stationary compressors totaling almost 25,000 hp. There was good reason for the contractors' preoccupation with air. Four diversion tunnels, each 56 feet in diameter and about 4000 feet in length had to be driven. Such a tunneling project would be a mammoth one even today. At the height of drilling in the tunnels, the compressors ran continuously for almost a year.

In the tunnels, the largest drill carriages or jumbos ever built at that time were brought into play. Each mounted 30 to 40 drifters. All in all, more than 500 air-using machines (the majority of them rock drills) were in use. They ranged from drill steel reconditioning equipment (at one time eleven complete blacksmith shops for drill steel were in full swing) to air-driven sump pumps. After the tunnels were completed, the air units were utilized almost at maximum capacity as the foundation of the huge dam was sunk deep into bedrock. Stoper drills hammered out the great penstocks and wagon drills chewed out a foothold for the powerhouses.

In later months and years as the concrete for the mammoth dam was poured, artificial cooling was required to extract the heat from the setting concrete. More than 600 miles of pipe was embedded in the structure and chilled water circulated through the maze. The chilled water source?—four of the same compressors that supplied air for the drilling were again in operation. Ammonia cylinders had been substituted for the air units and the great cooling coils of an 1100-ton-per-plant were connected to them.

**H**OOVER DAM was named one of the seven engineering wonders of the modern world and, as we pointed out when the selections were made, five other projects on the same list also relied extensively on the power of compressed air. We rather suspect that when future generations sit down to make a comparable selection of wonders that more than half of their selections will again pay silent tribute to compressed air technology.





SAVING  
WITH  
AIR POWER  
APPLICATIONS

## Clearing Barber Cuttings

W. U. McCoy

CHESTER MORELAND, veteran of 30 years of barbering, opened a new shop in Oklahoma City's Park Plaza shopping center a few months ago. His growing customer list is evidence of the response to the pleasingly decorated shop. But the one feature most welcomed by the customers is that after a haircut at Moreland's, they are never annoyed by stray clippings.

Moreland had long believed that a brush was not the best answer for removing clippings during and after a hair-cutting job. The brush could not be sterilized for each customer, and even when used carefully many loose clippings remained.

While watching his car being vacuumed at a service station one day, the barber thought that perhaps such a hose was the answer to his problem. Experiments showed that a blower hose worked better for his purpose than a suction type.

At his new shop he installed a small compressor in the utility closet, then ran  $\frac{3}{4}$ -inch tubing behind paneling to each of his three barber chairs,  $5\frac{1}{2}$  feet apart. Rubber hoses were attached at each station, coming out of chrome fittings attached to each chair station's cabinet. A local industrial supplier furnished Moreland with small lever nozzles—identical to those used to clean tools.

Although the automatic compressor can provide 100-psig pressure air, it has been adjusted to supply 20 psig. This does a thorough job of blowing away all stray hair clippings while creating no excessively strong air blast.

"Customers really like the idea," reports Moreland. "Practically every new customer comments about it, and I believe it has definitely played a part in the good increase in business we have had here." He explains that children "get a kick out of it" and their mothers

appreciate their youngsters being free of clippings.

Other barbers have shown interest in the air application, and Moreland has gladly described it to them. The installation was simple and the barber did the work himself. This interesting use of compressed air has improved his business at small expense by increasing the comfort of his customers.



**WHOOSH** Barber Chester Moreland gently blows away clippings with one of the three compressed air nozzles in his new Oklahoma City shop.

## Splitting Sandstone

QUARRYING of red sandstone in the Boulder, Colo., area formerly had been accomplished by the time consuming and tedious method of breaking out the stone manually with steel bars. Explosives could not be used because their fast action tended to shatter the stratified stone. The hand method kept the cost of the attractive building material at a high level.

The application of air power in conjunction with a tool designed originally for destruction of old concrete structures has helped solve the problem. The tool is the Duncan Hydraulic Roc-Jak, manufactured by the K. O. Duncan Company, Boulder, Colo. (the unit was described, in its concrete application, in *Compressed Air Magazine*, October 1954). The device is a hydraulic jack with ten pistons arranged vertically on a  $3 \times 24$ -inch hydraulic cylinder. The pistons are  $1\frac{5}{8}$  inches in diameter and will travel



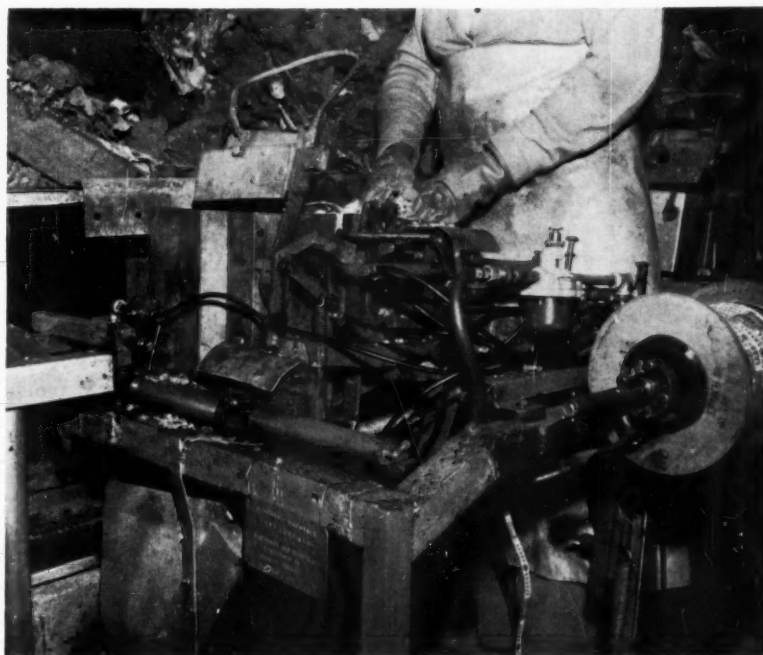
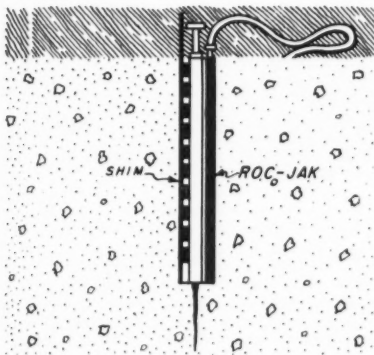
**SPLIT STONE** This piece of sandstone has just been split in a quarry near Lyons, Colo. At right is the chunk of stone. At left is the Rock-Jak unit out of the hole, showing the many-pistoned cylinder, the shim, and the pump. Two holes were drilled with a Jackhammer before the jack broke the stone.

outward 1 inch. A small, hand-powered pump develops 15,000-psig pressure. This force is delivered to the ten pistons by a hydraulic line; some 150 tons of total force is developed.

In operation in the sandstone, a Jackhammer is first used to drill a  $3\frac{1}{2}$ -inch hole into the stone using an Ingersoll-Rand Type 3 bit. The hole is put down 27 inches. Then the Roc-Jak is slipped into the hole and a shim inserted to provide a flat bearing surface for the ten pistons. The pump is operated and soon the stratified rock breaks, giving way to the great force. The piece of building stone is then removed from the quarry face to the floor, split along the strata lines, and sent to the cutting machine.

With the new method, one man can drill the hole, insert the Roc-Jak, and break off a 2-cubic-yard chunk of sandstone in 20 minutes. This is four times faster than the manual method.

The use of the air-powered Jackhammer, combined with the hydraulic unit, has greatly decreased the cost of producing the red sandstone. As well as making production less costly to the quarry operator, the work is done much more easily, and more of the handsome Colorado stone is available to builders.



**BUNCHING BROCCOLI** An operator holds a broccoli stalk prior to the tying operation. At right is the spool of tape for wrapping the vegetable. Also visible are double-acting air cylinders, return springs and hoses. This is an experimental model of the unit.

## Processing Vegetables with Air Cylinders' Aid

F. D. Lyon

**T**O SPEED tying of broccoli bunches, H. W. Mann and a mechanical engineer friend, John E. Rogers, collaborated 5 years ago to build an air-powered tying machine. Mann's home is in Salinas, Calif., in the heart of Southern California's vegetable growing district, and he knew how time-consuming were manual methods of handling the vegetables.

The machine the two developed is completely air-operated. First, a pneumatic gate valve, controlled by the machine operator, moves the broccoli to a holder on the unit. Another valve actuates a rotating valve that carries out several operations. It clamps the bunch securely, cuts off the stalks, feeds through the wire-cored paper tape that is tied around the bunch, and snips off the correct length of tape. A drive head grasps the tape's two ends and twists them tightly about the vegetable, then drops the bunch to a conveyor below.

In the machine's 360-degree tying cycle, opposed double-acting pneumatic

cylinders, having piston racks and pinions, provide all the rotating drive action. Single-acting and single-acting spring-return cylinders operate the various clamps. All cylinders are air cushioned.

One-quarter inch O.D. tubing feeds air from the rotating valve to the pneumatic cylinders. Air for the unit is supplied by a single-stage, 125-cfm capacity compressor driven by a 30-hp electric motor. Air at about 90 psig is stored in a 32×15-inch receiver.

Compressed air power was chosen as the best type for the machine because of possible oil contamination that might result from hydraulic operation, and because salt spray occasionally applied to the vegetables presented problems to electric operation.

Sixteen of the air-driven tying units are now in use and have speeded up production by 50 percent over the old methods. Further, after 2 years of heavy use, the efficient machines have failed to disclose any required design changes. The units are readily adaptable to handling other stalk vegetables, such as onions and celery.



# Air Jets

## Variations on a Theme

**C**OMPRESSED AIR is usually thought of as the motive power to drive a cylinder or motor, but there are instances when the power of a free jet or blast of air also can be utilized advantageously. The most common example is a compressed air hose with a nozzled end that is used to blow dirt from machinery and equipment. Equally well-known is the series of jets that blow water from metal parts that have just been through a washing machine. A reverse instance is sometimes encountered—as a vacuum hose that sucks water or foreign matter from crevices in castings, or similar objects, as they proceed along an overhead chain conveyor.

When bridging occurs in bins, hoppers and the like, air jets may be brought into play to dislodge the bridged bulk. Although vibrators are often seen in this service, one or more nozzles located so that they release strong air blasts in strategic directions when an air valve is operated makes an interesting and profitable variation.

Instances are also common in which one or more blasts of air may be utilized to move a piece of material in a specified direction a predetermined distance. No doubt the most common application is found on power presses where the mechanical upward action of the press ram or punch is used to trigger an air valve, and subsequently the air jet. The resultant blast blows either the workpiece or scrap into an adjacent tote box, onto a conveyor, or the like.

Air valves of all types have been developed for this purpose and can be timed with various machine motions to perform similar duties. One, for example, is the burnishing of the interior walls of drilled holes. Standard burnishing balls are pressed downward through the holes. After passing through them, they roll to a predesignated position from which they are blown upward by an air jet to their original position in the overhead hopper, ready to be re-released for another burnishing cycle.

A recent development, illustrated on this page, profitably utilizes air jets to break otherwise continuous veneer sheets

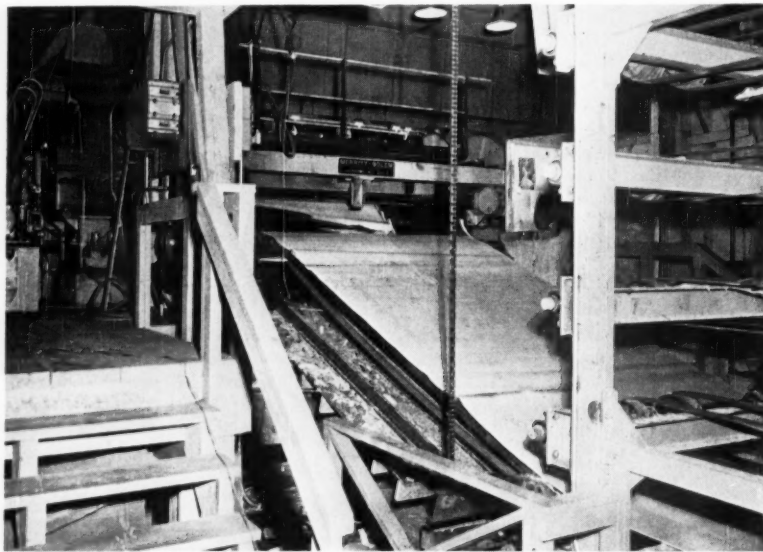
behind rotary veneer lathes. At a rotary lathe, once the exterior of a log has been rounded up, wood veneer is produced in a continuous sheet at a rapid rate. The veneer is cut by a Gargantuan knife mounted in a carriage that approaches at a specified rate over a pair of lathe ways. The veneer emerges toward a rough veneer clipper.

To provide storage of the single-sheet veneer between the lathe and the clipper without wasting great amounts of floor space, a multiple-deck storage system is used. Several decks are located, one above the other, in line with the lathe outfeed. Each deck has facilities for moving the sheet of veneer forward, away from the lathe and toward the rough clipper.

As soon as the continuous sheet has traveled forward over one of the decks,

its front end registers with the clipper end of the deck, and it has to be broken from the sheet behind the lathe before a new end can start toward the next deck. A swinging tippie is arranged between the lathe and the deck storage area. The forward end of this tippie can be swung up or down into registration with any of the decks it serves.

Although the continuous veneer sheet is often broken manually as required, a method now becoming popular uses an air jet. This breaker device can be operated automatically from a deck or tray control panel. Strong blasts of air snap the veneer at the proper point as the tippie begins its travel toward a new position, in registration with another deck or tray of the storage decks. Wood veneer as thick as  $\frac{1}{4}$  inch can be successfully broken in this manner.



**OPERATION VIEW** Looking directly at the veneer-delivery side of a modern rotary veneer lathe manufactured by Merritt-Solem Division of Solem Machine Company, Lockport, N. Y., the continuous sheet of veneer can be seen descending over the tippie from the lathe in the center of the picture. The tippie is delivering to the lower deck of the multiple-deck storage, shown at right. The tippie is trunnioned close to the lathe and can be instantly swung with its forward end to a point in registration with any one of the four higher decks. It is on a layout such as this that air-jet veneer breakers are used to break the sheet at the proper point and in correct timing with the fast swinging action of the tippie.



# Industrial Notes

**W**ATER-WELL drilling is the specialty of the Ingersoll-Rand Trucm-3 Drillmaster, whose features are described in a new bulletin, Form 4209. The publication lists the advantages of the Drillmaster and its Downhole drill, a unit that enters the hole and follows its own bit. A few of the Trucm-3 advantages are said to be its highly specialized design, its long drill life that means less maintenance, improved underwater drilling, longer bit life and faster, easier set ups. The rig's Downhole drill will put down holes of  $4\frac{3}{4}$  to  $6\frac{1}{2}$  inches diameter to a depth of 600 feet. As well as the Downhole unit, the Trucm-3 will also use rotary bits with air or mud for working in soft ground. A 2-page spread in the bulletin shows a picture of the Drillmaster and pinpoints the rig's features. Another spread reports the economy possible in sinking water wells and shallow oil wells, a page being devoted to each. Costs of actual drilling jobs are given. Other pages in the 12-page booklet provide specifications of the Trucm-3 and its Downhole drill. *Ingersoll-Rand Company, 11 Broadway, New York 4, N. Y.*

**A** DIFFERENTIAL pressure mass-flow meter precisely measures low flow rates to 200-psig pressure. Developed to satisfy industrial and research project requirements, the meter is said to represent the first instrument for accurately indicating such small flow rates. The unit has a 1-piece housing assembly. Its manometer tube is held in place by neoprene gaskets that are compressed on tube ends by means of seal screws. The metering element contains stacked beds of glass balls or microbeads and is screwed into the outlet fitting and sealed by O-rings. Gas passes through the metering element and out an outlet port. Due to resistance offered by the metering element, the gas

exerts a force directly related to this back pressure on the manometer fluid in the well. By observation of the fluid height, as it relates to scale readings, the mass flow rate may be determined with a standard accuracy of  $\pm 1$  percent of full scale. The meter is also usable for pneumatic or electric remote control and is adaptable for high pressures, high temperatures and corrosive media. The unit may be modified for panel mounting; two or more meters may also be grouped into a single compact unit. *C-Mar Corporation, 35 Euclid Avenue, Manasquan, N. J.*

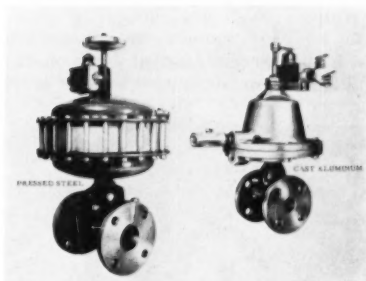
**F**ACTORY CLEANLINESS, always a watchword with plant engineers bent on pruning maintenance costs while achieving better production efficiency, is a simple matter with an Exidust Central Vac-



uum Cleaning System. The device consists of five components: a cyclone-type primary dust separator; a secondary bag-type separator; an exhaust and motor unit; a piping system; and fixed pick-ups or flexible nozzles. (The picture shows a unit with a flexible nozzle; fixed pick-ups, when fastened on machines where chips are formed, collect waste automatically.) The systems have a capacity ranging from 3 to 100 hp. They safely get rid of machine chips, especially flammables like plastics; keep machines free of chips, thereby lessening down time or operational wear caused by chips

lodging in vital machine parts; and salvage scrap for resale or reworking. Each installation is individually engineered to meet such variable factors as the number of operators, the type of operations, the size of hose and plant layout. *Lamson Corporation, Syracuse 1, N. Y.*

**A** LARGE-volume air chamber located on one side of a diaphragm is a chief feature of an air-loaded, springless valve



operator. The unit is built for use with the manufacturers' miniature valves. The air chamber is pneumatically loaded at any desired pressure and sealed by a check valve. Signal air, admitted to the other side of the diaphragm, forces the diaphragm into the air chamber when the signal exceeds the chamber preloading pressure. Compression of the trapped chamber air returns the operator to normal position when signal pressure drops. The unit can be furnished in normally closed or normally open models in pressed steel or cast aluminum cases. All models have travel indicators and can be easily equipped with microswitches. *George W. Dahl Company, Inc., Bristol, R.I.*

**A**NSUL CHEMICAL Company, a pioneer in the field of dry chemical fire fighting equipment, has published a catalog that displays its 1960 line of fire equipment. Included are hand portable extinguishers, stationary fire equipment, pipe systems and large-capacity mobile equipment such as fire jeeps and trucks. Among the new portable units featured are the Monitor extinguisher and the Sentry Energized series. The former contains  $2\frac{3}{4}$  pounds of dry chemical in a spherical shell topped by a discharge head. It is said to be the only extinguisher that has a factory-filled recharge shell listed by Underwriters' Laboratories. The Monitor can be recharged by removing the used shell and replacing it with a fresh one—like changing a light bulb. Sentry extinguishers, constructed on the stored-pressure principle, are available in 10-, 20-, and 30-pound capacities. Their design differs significantly from conventional stored pressure extinguishers particularly in the 1-hand

operation feature. Copies of the bulletin (Form No. F5975) are available from the company's catalog department. *Ansul Chemical Company, Marinette, Wis.*

**H**I-FLO air line couplers are designed "to make compressed air as easy to use as electricity." The check unit and adapter of the coupler lock together with a snap, and, once closed, will not accidentally pull apart when snagged on machinery or dragged across the floor. The couplers connect and disconnect easily, and a heavy knurled sleeve on the check unit provides nonslip action even



when hands are gloved or covered with grease. In addition to their safe, positive operation, they allow more air to flow, thus increasing the efficiency of air

tools and equipment. Air flow through the couplers is approximately 65 cfm at 100-psig pressure. The units are specially designed and made from corrosion-resistant case-hardened steel to withstand rugged operation and to provide long service life. Further, they are interchangeable with similar types in use throughout industry. *A. Schrader's Son, Division of Scovill Manufacturing Company, 470 Vanderbilt Avenue, Brooklyn, N. Y.*

**R**OTOBLAST Table-Rooms, Models LK and LM, are described in Bulletin 805. They are designed to clean castings or weldments as large as 10 feet wide and can accommodate material weighing as much as 6 tons. In addition to photographs and cut-away diagrams, the brochure gives complete dimensions and specifications of eight Table-Rooms, including a 2-table variety. *Pangborn Corporation, Hagerstown, Md.*

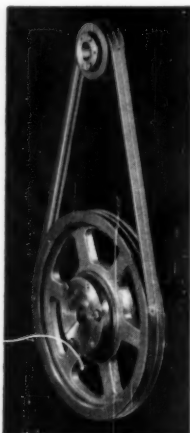
**I**NGENIOUS SPRING design has made possible a small, lightweight high-pressure reducer for air or nitrogen. Gas at a pressure of 3000 psig can be reduced to any pressure between 300 and 1800 psig by selecting the proper spring for the assembly. The reducer's balanced design is said to assure excellent control



of the downstream pressure. The assembly can be used in a wide variety of applications, some of which include use in gyro, turbine control, fuel expulsion, reaction jet, stable platform, auxiliary power, and electronic pressurized systems. *Walter Kidde & Company, Inc., Belleville 9, N. J.*

**P**OROLOY wound wire porous metal for filtration and nonfiltration applications is the subject of technical brochure BFD-141. Detailed with photographs, drawings and curves, are the capabilities and typical examples of wound wire porous metal. Descriptive examples include stainless steel and super alloy Poroloy and low-cost Poroloy CS, which is made from low-alloy and carbon steels. Specifications and curves for flow rate and physical characteristics are presented. *Bendix Aviation Corporation, Bendix*

## NEW WOOD'S ULTRA-V DRIVES OFFER TREMENDOUS SAVINGS!



UV/960

Wood's new Ultra-V Drives offer tremendous savings over conventional v-belt drives . . . up to 50% in space, 27% in weight, 30% and more in costs. And there are savings on bearings, bases and housings. New, greatly improved belt materials and new belt construction assure unmatched dimensional stability, amazing strength, greater grip, added support and equalized load for tension members. New, high performance, Ultra-V Sheaves have smaller diameters, less width, less weight and tremendous strength, are equipped with famous "Sure-Grip" Bushings.



write for bulletin 9102

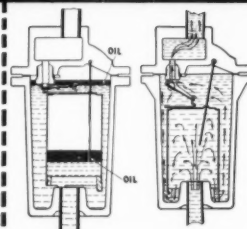
**T. B. WOOD'S SONS COMPANY** CHAMBERSBURG, PA.  
ATLANTA • CAMBRIDGE • CHICAGO • CLEVELAND • DALLAS

## OIL WON'T STOP UP THIS AIR TRAP

Oil from heavy-duty compressors clogs ordinary ball-float traps—but not an Armstrong inverted bucket trap. The diagram at right shows how it handles even heavy oil.

(Warning—even an Armstrong will not handle oil-water emulsions described as "warm peanut butter".)

- **Handles Dirt**—No dead spots for dirt to collect. Dirt stays in suspension, won't settle on valve or seat—they're at top of trap.
- **Trouble-Free Construction**—Stainless steel working parts; heat-treated chrome steel valve and seat, lapped to a precision fit.
- **Flexible Installation**—Installs above or below unit being drained, because of air bleed. Slight air loss (7-10 cu. ft./hr.) costs only about a penny a day, figuring air at 6¢ per 1000 cu. ft.
- **Low Cost, High Capacity**—On a size for size basis.



**How It Works**

**CLOSED:** Oil collects on top of water in trap. Air in trap floats bucket. Valve held closed by pressure.

**OPEN:** When water displaces air in bucket, bucket sinks, pulls on lever and opens valve. Oil floats out along with condensate.

### SEND FOR BULLETIN

Bulletin No. 2024 shows how to select air traps for any job. Also gives complete data on all Armstrong air traps. For a copy, call your local Armstrong Representative, or write:

**ARMSTRONG MACHINE WORKS**

8851 Maple Street, Three Rivers, Michigan





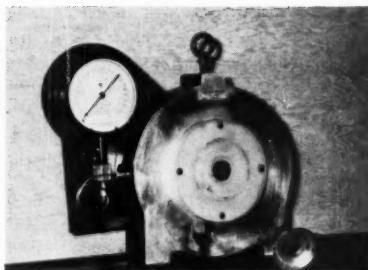
Filter Division, 434 W. Twelve-Mile Road, Madison Heights, Mich.

**H**I-VELOCITY electronic air cleaners are the subject of Dollinger's 12-page bulletin, Number 405. The brochure is complete with descriptive diagrams, photographs and specifications for all six models in the company's line, each of which can be either field assembled or cabinet-unit formed, and all of which feature unit construction. *Dollinger Corporation, Rochester 3, N. Y.*

**T**OTALIZER is a handy device that can be used as an air meter, a maintenance guide, an efficiency checker, an operating guide where more than one compressor is installed, and an indicator of potential compressor capacity needed. Manufactured by Siewert Equipment Company, it indicates the time a compressor has run at each stage of loading. It also tells operating personnel when to plan a major overhaul, valve overhaul or installation of additional capacity. As a meter, it provides an accurate indication of the total air produced. Details and ordering information are given in the manufacturer's bulletin. *Siewert Equipment Company, Inc., 175 Akron Street, Rochester 9, N. Y.*

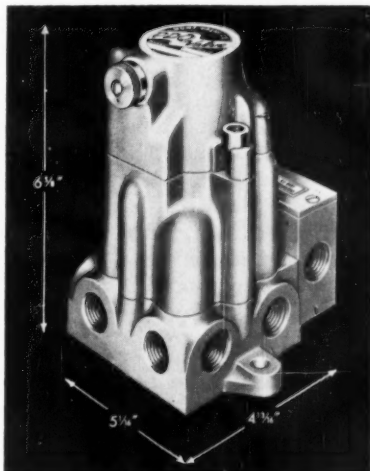
**P**ROTRACTOR, straight edge and scales—all are combined in the single, handy instrument called Draft-All. Complete mechanical drawings can be constructed with it. This drawing device is a standard 8-inch, 45/90-degree plastic triangle that has permanently stamped into it the four most popular scales—1-, 1/4-, 1/6-, and 1/10-inch—as well as guide lines for the construction of 90-, 75-, 60-, 45-, and 30-degree line intersections. Not only is it easy to use, but it can be conveniently stored or carried into the field for on-the-spot drawings. Its conveniences will be appreciated by professional draftsmen as well as those individuals who make occasional drawings but who do not have regular drafting equipment facilities. Its low cost—\$2—includes a protective jacket, and the Draft-All may be ordered directly from the manufacturer. *Draft-All Triangle Company, 152 W. Forty-second Street, New York 36, N. Y.*

**P**RECISION CALIBRATOR, Model K, has been designed by Skidmore-Wilhelm to test tensile strengths of large-diameter bolts and studs. The unit was developed to measure bolt loads to 225,000 pounds; in general, it may be used with bolts and studs to 2 1/2-inch diameter. Reportedly this is the first time that measurements could be made of bolt loads in these ranges. The calibrator is



portable, direct-reading, self-contained, and is certified accurate within 2 percent. *Skidmore-Wilhelm Manufacturing Company, 442 S. Green Road, Cleveland 21, Ohio.*

**W**ELL-NAMED, the PDQ air control valve can be replaced, including plug-in solenoid, in less than 30 seconds, according to the manufacturer. The unit can be completely removed by loosening two cap screws, twisting the pilot cap, and removing it and the valve housing. The valve has only two replacement parts: a poppet spindle-sleeve assembly and a solenoid pilot assembly, each of which is a self-contained unit. Repacking re-



quires no tools and takes less than a minute. Even with these features, the PDQ valve is a full 1/2-inch NPT valve that will flow 335 cfm with 100-psig initial pressure to atmosphere. The valve, which has a short-stroke pilot that actuates a compact, full-orifice poppet spindle, is available in tap sizes of 3/8, 1/2 and 3/4 inch. *Hunt Valve Company, Salem, Ohio.*

**S**MOOTH, fully controlled hydraulic feeds for punching, clamping, riveting, shearing or pressing metals or plastics are powered by shop air. They are compact, self-contained and require no pumps or motors. It is reported that

## ADAMS FACT FILE #2

### PLANT AIR

#### Moisture Chief Cause of Trouble...

Every company today is looking for ways to offset the increased costs of labor, material, equipment and services. At a gasoline station you expect "Free Air", but in industry it is a major expense. Perhaps in your own plant, for an investment in a few minor compressed air system alterations, significant savings are possible.

Water, sludge, rust, oil and dirt in compressed air systems are prime causes of maintenance and production down-time. Water vapor condensing in air lines tends to corrode the piping. Also, water present in the piping may freeze during winter, causing serious reduction of compressed air supply. Such restrictions are often difficult to locate and thaw. This same line moisture may emulsify lube oil destroying its lubricating value and the resultant mixture has high fouling characteristics. Frequently, ice will form within the tool itself since expanding air cools the moisture... tool efficiency will be seriously affected.

#### Some of the Other Problems Created By Wet Compressed Air...

Wet compressed air is not only a construction and production tool problem. Faulty paint jobs, contaminated chemical and food products can often be traced to moisture laden compressed air. Water-hammer, unequal pipeline thermal expansion and line leaks also result from collected moisture. In addition, air lost through traps, and in blow-down of compressed air lines provide no useful work... represent a sizeable power loss.

#### You Can Lick Compressed Air Moisture Problem...

All of these hidden costs can be virtually eliminated by the installation of an Adams Aftercooler and Cyclone Separator between the compressor and receiver tank. By cooling discharge air to within 10° F. of cooling water temperature—guaranteed with Adams standard Aftercoolers—the moisture can be removed at the separator. Pressure loss is less than one-half pound on these units including the separator. In severe cases, moisture removal of over 90 per cent can be obtained by cooling the air with Adams 2° Aftercooler to within 2° F. of water temperature.

#### Air Filter for Final Protection at Point of Use...

As an added safeguard for expensive tools and equipment, an Adams Poro-Stone Air Filter should be installed just before the air is used. These filters remove all solid material picked up by the air stream. With an Adams Aftercooler, Cyclone Separator and Air Filters clean, dry, trouble-free air is supplied to your production tools. You get continuous service with minimum maintenance.

For further information on how the complete line of Adams air equipment can solve your compressed air problems, write today for your free copy of Bulletin No. 712 on Aftercoolers and Bulletin No. 117 on Poro-Stone Air Filters from the R. P. Adams Company, Inc., 209 East Park Drive, Buffalo 17, New York.

there is no "bounce," either at the point of break-through or when a load is released. Almost any sequence of opera-

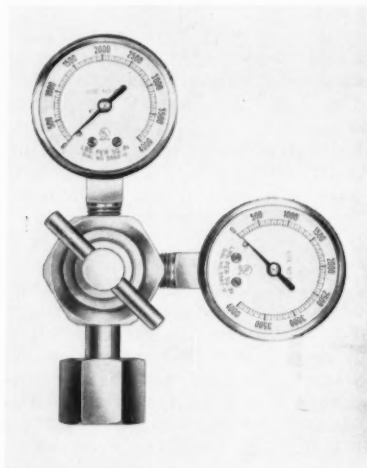


tions may be performed automatically by using trigger valve actuators or solenoids. For milling or surface grinding, the feeds are adjustable to proper rate

of feed in inches per minute for various materials. In drilling, they are said to increase efficiency and prolong tool service. *Superior Controls, P. O. Box 436, Commercial Road, Crystal Lake, Ill.*

**R**EGULATORS, designated as RegO Model 10806, are slightly less than 6 inches tall, but can reduce pressures as high as 3000 psig to the 0-1500-psig range. Delivery pressures may easily be adjusted by a turn of the T-bar adjusting screw shown in the illustration. They are especially suited for use in gaseous oxygen service where a relatively light flow is required. A wide variety of

inlet connections is available, according to a company report, for any high-pressure, noncorrosive gas. The brass

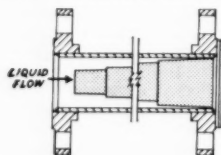


body and bonnet are equipped with both inlet and delivery pressure gauges. *The Bastian-Blessing Company, RegO Division, 4201 W. Peterson Avenue, Chicago 46, Ill.*

## NEW PIPING STRAINERS

*Simplify removal of objectionable dirt from any piping system*

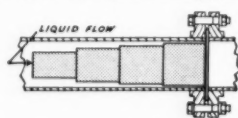
Elimination of objectionable dirt particles and other foreign matter from air, gas or liquid streams is accomplished effectively with Air-Maze Piping Strainers.



*Installation of Air-Maze Piping Strainer in pipe strainer body.*

For economy of installation, these strainers are mounted directly into any line using conventional Schedule 40 S pipe and Series 15 flanges. Cylindrical in design, the metal media has multiple steps to provide maximum filtration area. Media in opening sizes .0013" to .0307" can be supplied. Maximum operating temperature 250°F. Maximum pressure drop 50 psi.

Furnished with pipe strainer bodies, where required for nominal pipe sizes from 2" to 24". Write Air-Maze Corporation, Department CA-2, Cleveland 28, Ohio. (Subsidiary of ROCKWELL-STANDARD Corporation)



*Installation of Air-Maze Piping Strainer in flange pipe.*

# AIR-MAZE

**The Filter Engineers**

**AIR FILTERS • SILENCERS • SPARK ARRESTERS • LIQUID FILTERS  
OIL SEPARATORS • GREASE FILTERS**

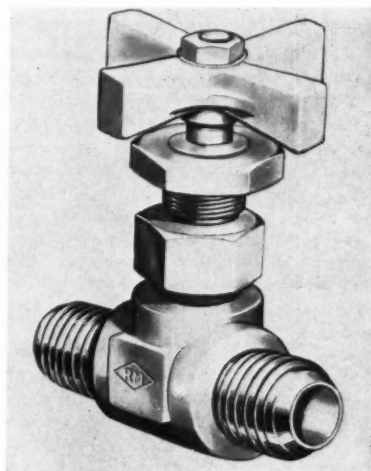
**A** PURGE METER indicates small gas or liquid flows where extremely high accuracy is not required. Called the Series C M Purge Meter, the unit is intended for general purging application in which only a positive flow indication as well as reproducibility of small flow conditions is of prime importance. Of solid acrylic plastic, the meter is drilled, reamed and polished to provide economical, trouble-

free operation. Its body has a high impact strength and is resistant to normal atmospheres and media. Tubes machined directly into its body are said to completely eliminate the need for spare parts or expensive repairs. A valve offers control of flow rates and an etched scale permits quick readings. *C-Mar Corporation, 35 Euclid Avenue, Manassquan, N. J.*

**D**EHYDRAFILTER units, Models CM-4-06 and CM-6-1, are discussed in a 2-page bulletin from Hankison Corporation. Included are cross-sectional drawings, specifications, and a general description of all models of the Dehydrfilter-desiccant-cartridge units that remove vaporized moisture and oil from

low-volume, high-pressure compressed air. The first-mentioned model is rated at 4 scfm at 600-psig pressure and 70° F; Model CM-6-1 is rated at 6 scfm at 1000-psig pressure and 70° F. The units are used on louver and damper controls, pneumatic equipment on dead-end or low-flow service, and jet aircraft test stands. *Hankison Corporation*, College & Pike, Canonsburg, Pa.

**S**MALL-LINE circuitry—including instrumentation, gauge cut-off, test panel and manifold applications—is the function of a series of valves that handle pressures to 3000 psig. The miniature needle valves have the trade name Instru-needles. A wide variety of port threading combinations enable direct connections that save space, and reduce installation and maintenance costs. Both in-line and angle designs are avail-



able in brass and stainless steel, for either regular or panel mountings. One-eighth and 1/4-inch internal and external pipe, and 1/4- and 3/8-inch O.D. flared and flareless tube threadings are standard. The temperature range of the units is from minus 65° to plus 450° F. Bulletin 959 explains the valves. *Republic Manufacturing Company*, 15655 Brookpark Road, Cleveland 35, Ohio.

**S**TEAM cleaning and flash-fire protection in refineries and blowing out in shipyards, foundries and steel mills is made safer, according to Raybestos-Manhattan, with No. 200 BW steam hose, for it features braided steel wire burst protection. Two braids of high-tensile, multiple-end, noncorrosive steel wire are stretched over an asbestos-covered inner-tube of thick heat-resisting rubber. Designed for use to 200 psig saturated steam pressure at 388° F, the braid construction gives unusual strength and flexibility, and assures maximum safety.

## CONTINENTAL RED SEALS ARE ENGINEERED TO FIT THE JOB

Rarely will you find an item of industrial, construction or road building equipment that won't run best and cheapest on Continental Red Seal power. The reason lies in specialization—in Continental's long-standing policy of engineering each model precisely to the work to be done. Whatever the machine . . . whatever its job . . . you can bank on it for abundant power at the speeds consistent with low fuel and upkeep cost.



Continental's ruggedness and rightness of design are helping to build prestige for more and more of the leading builders of specialized power equipment. It's wise when buying equipment of this type, to choose a make with dependable Red Seal power—power backed by specialized experience dating from 1902.

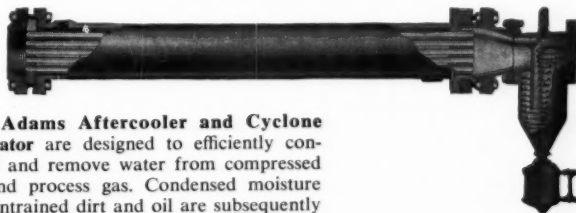
SERVICE AND PARTS  
AVAILABLE EVERYWHERE



**Continental Motors Corporation**  
MUSKEGON • MICHIGAN

## Aftercooler and Cyclone Separator designed for cleaner, dryer compressed air

R. P. ADAMS CO., INC.  
209 East Park Drive, Buffalo 17, New York



**The Adams Aftercooler and Cyclone Separator** are designed to efficiently condense and remove water from compressed air and process gas. Condensed moisture and entrained dirt and oil are subsequently removed in a cyclone type separator. This unit is scientifically designed for maximum removal efficiency over a wide range of flow rates.

For normal use, units are available to cool gases to within 10° F of the temperature of the cooling water. Specially designed units are available to permit a 2° F approach to cooling water temperature, for application where low moisture content is critical.

Adams Aftercoolers and Separators are available from stock to handle 20 - 40,000 cfm with 10° cooling and 25 - 19,200 cfm

where it is necessary to cool within 2° F of the cooling water. Special units can be supplied to suit an unlimited range of requirements. In all cases the maximum pressure loss at rated capacities is 1/2 psi.

This wide range of sizes enables the economical utilization of Adams Aftercoolers and Separators in virtually all industrial application. For further information on how R. P. Adams' units will solve your compressed air problems and save you money, write today for Bulletin 711.



# REDUCE MAINTENANCE COSTS

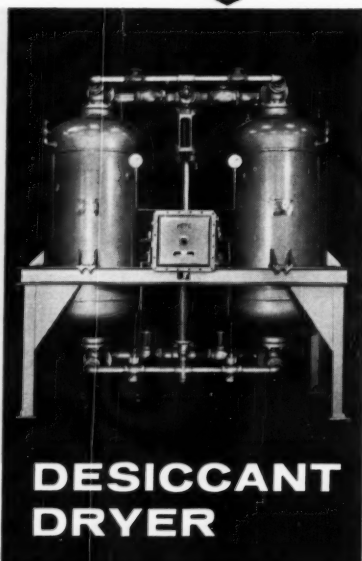
Moisture and oil in your air system will result in costly repairs, down time, and even system failure. Moisture causes rust that clogs delicate sensing devices, slows down pneumatic controls, and in some cases, brings about total destruction of expensive equipment. Random oil in an air system forms sludges, gums and hard varnishes, causing instrumentation and control breakdown.



## Heat-Les

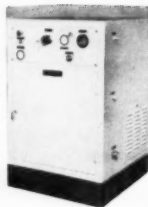
The Trinity Heat-Les dryer makes possible the driest air of all. This amazing dryer is being used in hundreds of industrial and military installations, and establishing new records for dependability, economy and performance.

- Dewpoints to -200°F.
- Low initial cost.
- No heaters to replace or power.
- No increase in air temperature.



**DESICCANT  
DRYER**

Heat-Les dryers are available in many sizes, for all pressures, from 1 scfm to 5000 scfm. Larger volumes may be handled through combinations of units. Also, in complete, unitized dry air systems, including compressor, accumulator and instrumentation



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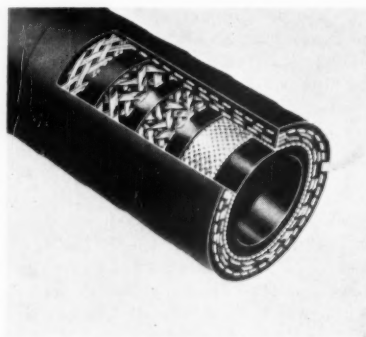


*World leader in dry gas systems*

Heat-Les Dryers • Heat-reactivated Dryers  
Thermocouples and Thermowells

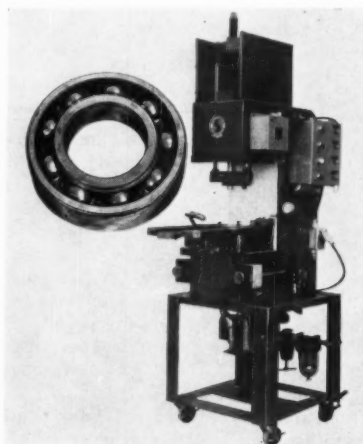
TRINITY EQUIPMENT CORPORATION, CORTLAND, NEW YORK

The hose is virtually burstproof because the wire braid prevents open bursting. Static conductors make for the utmost of



safety in refineries. The hose is available in sizes from 1/2 inch to 2 inches. Raybestos-Manhattan, Inc., Manhattan Rubber Division, Passaic, N. J.

**T**HE PRESS illustrated below is used to stake retainers in roller bearings, one of its possible production assembly operations. It is a standard 10-ton model; others have 1 1/2, 2 1/2, and 5-ton capacities, and all operate at 80 psig air pressure. The presses are capable of ram speeds to 2500 cycles per hour. Each is equipped with two hand safety controls, wired for either momentary contact through timer control for positive stroke cycle or manual control. The half-inch power stroke is initiated by a microswitch. The positive mechanical ram down-stop operates independently of oil or electrical circuits, and is adjustable to close tolerance. The space between the ram and bottom plate is 16 inches, throat depth is 8 inches and the ram stroke is 8 inches. Descriptive literature is available from the manufacturer, which also discusses other precision applications. Studebaker Hydraulic Products Company, 1733 N. Thirty-third Street, Melrose Park, Ill.



Here is the pair  
for clean, dry  
air . . .

#### JOHNSON AFTERCOOLER

Used where moisture is vaporized by the heat of compression. Circulates cooling water around the line, condenses the oil and water vapor so Separator can remove them. Simple in design, highly efficient in performance.

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FOR ALL  
NEEDS

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SEPARATOR**  
Removes more than 99% of all water, dirt and oil from compressed air or steam. Combines the two best principles of separation—first allows air to expand slightly, then changes flow direction with the "Thousand Baffles", the newest idea in separator design, with self-draining trap mechanism built right in.

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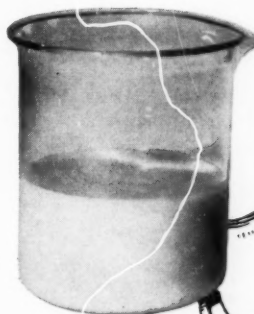
**The Johnson Corporation**

830 Wood Street • Three Rivers, Mich.

## WHAT YOU SHOULD KNOW ABOUT AIR TOOL UPKEEP



**Ordinary oil**  
separates from water



**NON-FLUID OIL**  
TRADE MARK REGISTERED

**emulsifies with water**

The NR grades of NON-FLUID OIL work on the principle "if you can't lick moisture, join it." They emulsify permanently with airborne moisture . . . go right along with it and protect working surfaces from rust and corrosion, sticking and gumming. Result: your air tools deliver top power and operating efficiency.

That's why pneumatic tool manufacturers use and recommend the NR grades of NON-FLUID OIL for their equipment, and why the NR grades are employed by hundreds of major air tool users. Write for free testing sample and Bulletin No. 550. See for yourself.

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Also represented in principal industrial centers, including Pittsburgh, Pa., Cleveland and Cincinnati, Ohio.

NON-FLUID OIL is not the name of a general class of lubricants, but is a specific product of our manufacture. So called grease imitations of NON-FLUID OIL often prove dangerous and costly to use.



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HANDY  
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**The Engineer, The Superintendent, The Operating Man**

#### CAMERON PUMP OPERATORS' DATA:

Contains practical information covering the installation, operation and maintenance of centrifugal pumps.

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Covers data useful in work involving the handling of liquids, steam, and water vapors.

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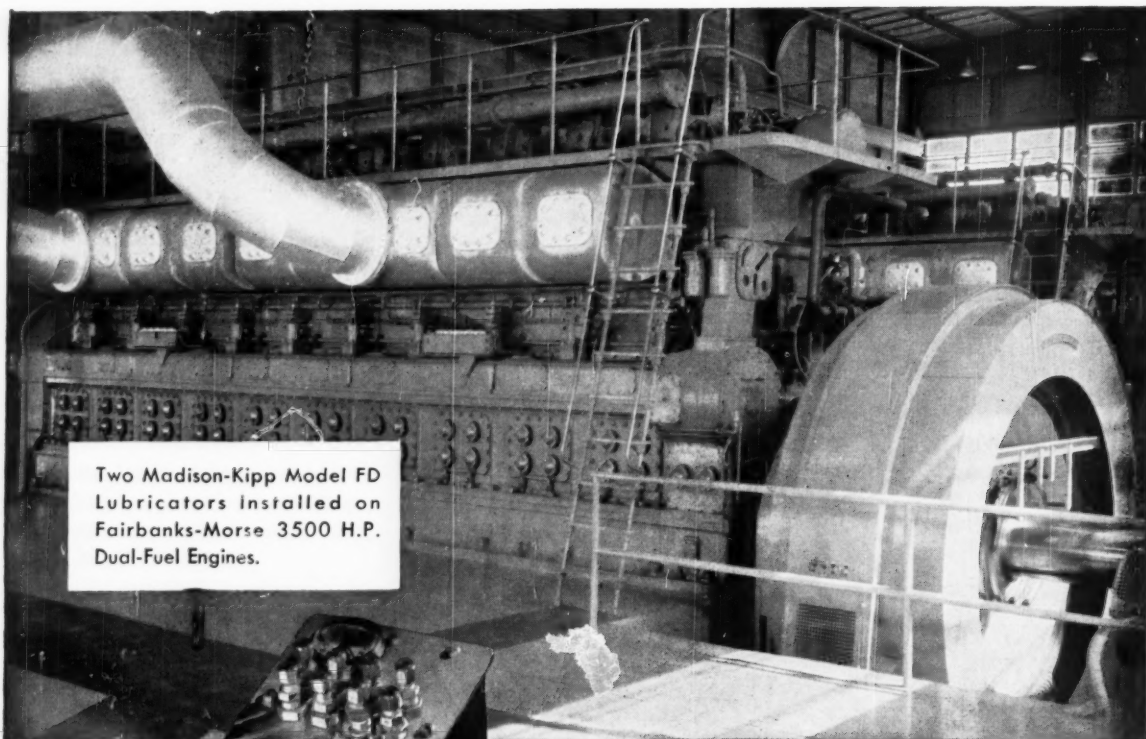
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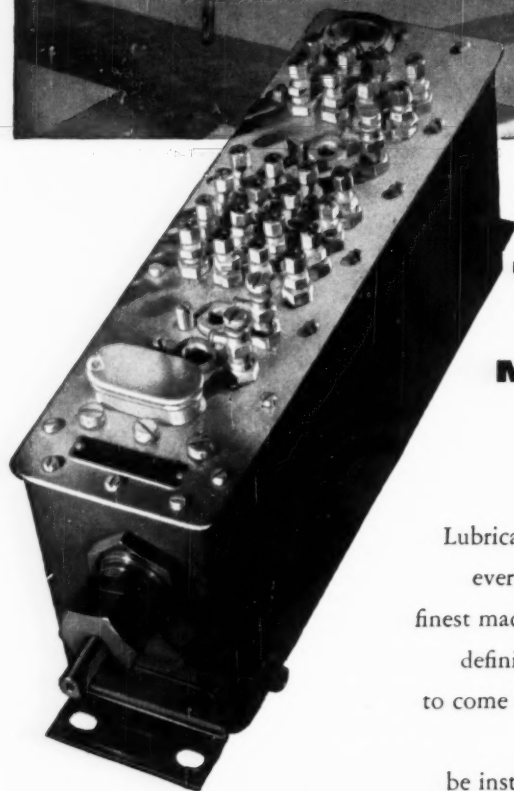
**COMPRESSED AIR MAGAZINE**

**942 Memorial Parkway**

**Phillipsburg, N. J.**



Two Madison-Kipp Model FD Lubricators Installed on Fairbanks-Morse 3500 H.P. Dual-Fuel Engines.



**Machines of great performance  
use the most dependable  
oiling system ever developed  
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...by the measured drop, from a Madison-Kipp Lubricator is the most dependable method of lubrication ever developed. It is applied as original equipment on America's finest machine tools, work engines and compressors. You will definitely increase your production potential for years to come by specifying Madison-Kipp on all new machines you buy, where oil under pressure fed drop by drop can be installed. There are 6 models to meet almost every installation requirement.



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**Skilled in Die Casting Mechanics • Experienced in Lubrication Engineering • Originators of Really High Speed Air Tools**



*All Pressure Regulators are not alike*

**Norgren**

## **Baffle and Siphon Tube Construction**

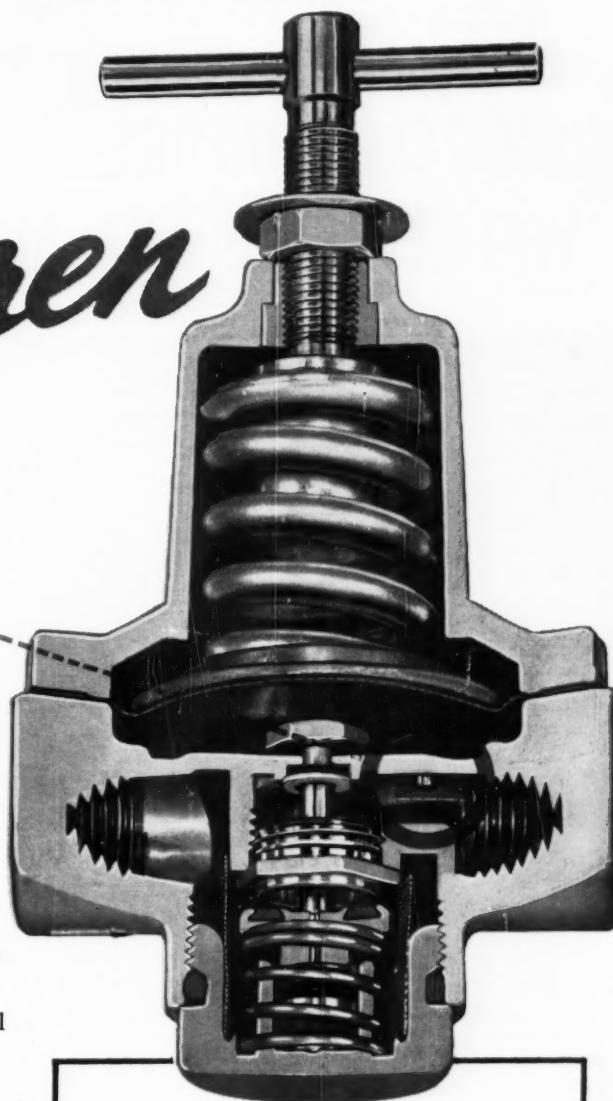
*provides more uniform  
regulated pressure  
as flow demand changes*

In the ideal pressure regulator there would be no change in the regulated pressure no matter how wide the variations in the flow rate.

Norgren Pressure Regulators approach this ideal by providing a baffle and siphon tube feature. This increases the sensitivity of the valve to changes in the flow rate through the regulator and provides better performance and a more uniform regulated pressure over a wide range of flow rates.

The baffle protects the diaphragm from pressure shock and abrasive action. This gives you longer regulator life, more dependable operation and minimum maintenance.

**For complete information on all your regulator needs, 1/8" to 2", call your nearby Norgren Representative listed in your telephone directory—or WRITE FACTORY FOR DESCRIPTIVE LITERATURE.**



### **Norgren Pressure Regulators give you these important features:**

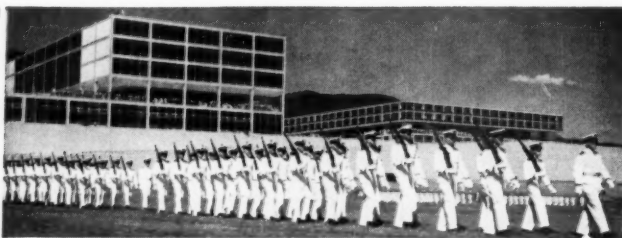
- Balanced Valve Construction—improved regulator performance
- Large Nylon-reinforced Buna N Synthetic Rubber Diaphragm—long service life
- Baffle Plate and Siphon Tube—increased accuracy
- Large Passages and Valve Openings—large flow capacity
- Easy servicing while still on air line
- Flexible Valve Pin—assures better seating

FOUNDED IN 1926

# **C. A. NORGREN CO.**

3407 SOUTH ELATI STREET • ENGLEWOOD, COLORADO

Without breaking step, students march down ramp leading from academic and cadet living area onto the parade ground.



# HIGH TEMPERATURE WATER HEATS THE AIR FORCE ACADEMY

*Skidmore, Owings & Merrill, Architects; Syska & Hennessy, Inc., Associate Engineers; J. O. Ross Engineering Corp., HTW Consultants*



Compact and efficient, these three C-E LaMont Controlled Circulation Hot Water Boilers serve in the Academy's Academic Area plant. Each has a rated output of 100 million BTUs per hour.

Nestled against the Rampart Range of the Rockies, the Academy presents an impressive sight from the air. Buildings, from left to right, are: Fairchild Hall, the Academic-Library Building, with Aerodynamics-Thermodynamics Lab and Mitchell Hall (Cadet Dining Hall) behind it; Vandenberg Hall, the Cadet Dormitory; Harmon Hall, the Administration Building; Arnold Hall, the Cadet Social Center; and Planetarium (dome at right). The parade ground stretches at left from sloping ramp. The Physical Education Building and athletic fields are at lower right.

Nestled picturesquely in the Rampart Range of the Rockies, seven miles north of Colorado Springs, the new U. S. Air Force Academy is a fitting symbol of the prowess and prestige earned by this branch of our military.

Situated on a sloping site, the Academy grounds are graded, split-level fashion, into a number of broad terraces. Elevations range between 6,400 and 7,000 feet above sea level. The school is divided into two general areas — one for service buildings and one encompassing academic, physical education, dormitory and hospital facilities.

Selecting a heating system to service these widely-spaced buildings and facilities over the rolling and varying terrain required a type that permitted easy and economical pipe line distribution over individual closed circuits exceeding six miles in length — circuits which totally encompass nearly fifteen miles.

Because of the irregular terrain and the large area, a steam system would have required a substantial number of steam traps and close attention to piping gradients. High temperature water, on the other hand, offered the advantages of smaller-sized piping with no pressure valves, and a smaller, more compact boiler plant than would have been required for steam . . . with 10 to 20 per cent reductions in operating costs.

There are five C-E LaMont Controlled Circulation Hot Water Boilers serving the Air Force Academy. They are located in two separate boiler plants — 3 in one and 2 in the other — and have been performing reliably, efficiently and with minimum operating attention since they were first placed in service in late 1957.

For details on C-E Hot Water Boilers, write for catalog HCC-2 — no obligation, of course.

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Combustion Engineering Building, 200 Madison Avenue, New York 16, N. Y.

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ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; POLYMERIZERS, FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

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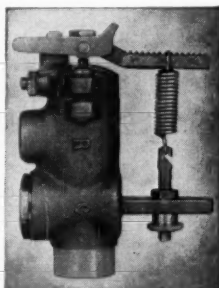
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# UNLOADER VALVES

any age

any make

any condition



One day is all it takes to change old, worn-out unloader valves into factory rebuilts with new valve guarantee. Conrader exchanges all makes. Cost 1/3 less than new valves.

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## The Pulsation Compensated

# AIR METER

4 Ranges Covering From  
4 to 450 CFM



- SIMPLE AND PRACTICAL OPERATION
- RELIABLE AND DURABLE
- PORTABLE FOR FIELD TESTING
- ACCURACY BETTER THAN 99%

New Jersey Air Meters are accepted everywhere as the most practical, reliable and accurate method of air measurement. With the aid of these meters, you can intelligently select the most suitable equipment for your service, maintain this equipment in effective operating condition, make repairs and adjustments when needed, locate leaks and losses, and scrap the "air eaters" when they become obsolete or worn beyond repair.

These meters show directly on a scale, in cubic feet of free air per minute, the flow of air in a pipe or hose. They measure the air consumption of any pneumatic tool, rock drill, air motor, sand blast, air lift, or other application of compressed air. They permit the control of air flow to any operation or process at the rate that gives the most effective production and highest air economy.

FOR THE COMPLETE STORY, WRITE FOR BULLETIN A-8

**NEW JERSEY METER CO., INC.**

350 Leland Avenue • Plainfield, New Jersey

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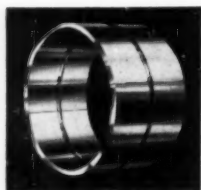
# 60,000 HOURS . . . WITH NO BEARING WEAR

in this  compressor

Sound unbelievable? Here's how it happened.

This 125-hp Ingersoll-Rand XLE compressor was installed in 1950 at the Standard Products Company in Cleveland. By the summer of 1958 the unit had totalled approximately 60,000 hours of operation, averaging 20 hours a day, six days per week. It was shut down for complete annual inspection as part of the plant preventive maintenance program.

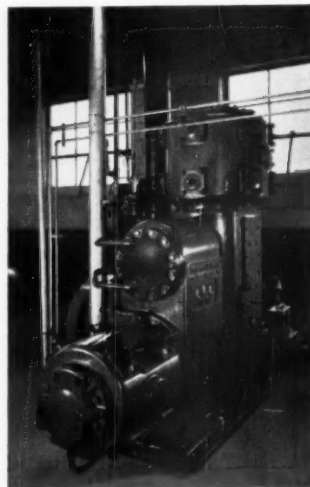
Long before the unit was shut down the customer had ordered new main bearings to keep in reserve stock in event of emergency. It was decided to install the new bearings while the compressor was torn down for inspection. When the old bearings were removed they were checked for wear and were found to be within the original one-thousandth-inch tolerance for new bearings. This means that there was *no measurable wear*, even after the equivalent of 20 years of "normal" operation!



Of course, these are not ordinary bearings. They are *aluminum full-floating* bearings, one of the extra-value features found only in Ingersoll-Rand compressors. These heavy-duty bearings roll with the punch of each compressor stroke, distributing the load evenly all around the inside and outside of the shell. Their special aluminum alloy has better load-carrying capacity and higher heat

conductivity than other bearing materials. And they *never need adjustment*, so the running gear may be kept sealed from dust and dirt.

Ingersoll-Rand compressors have many more extra-quality features that can save you money in your plant. Call your I-R representative—he has the solution for any compression problem.



The World's Most Comprehensive

Compressor Experience . . .

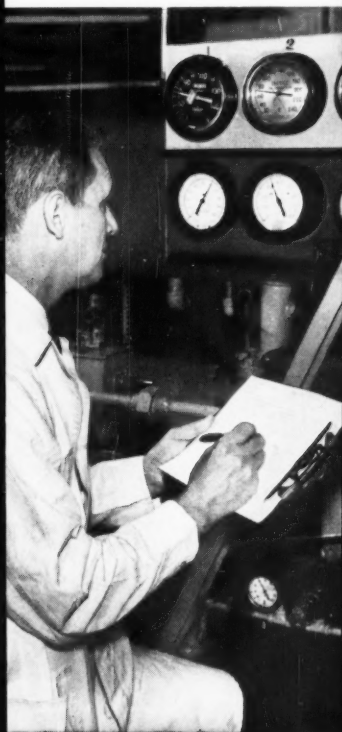
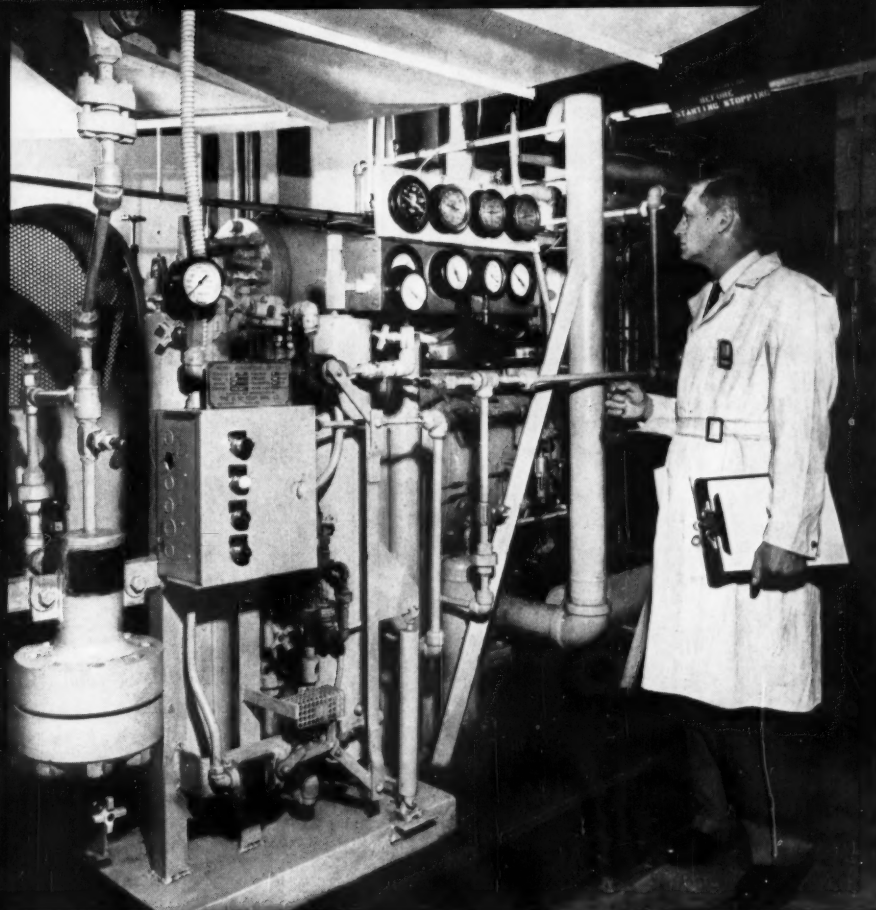
**Ingersoll-Rand**

1-982

11 Broadway, New York 4, N. Y.

Right  
Four-stage air compressor in  
operation at Hamilton Standard  
Division of United Aircraft,  
Windsor Locks, Connecticut.  
Fire resistant Celanese Cellulubes  
materially reduced downtime  
and maintenance costs.

Below  
Mr. Robert Fredrickson, Foreman,  
checks compressor operation.



## Air cost extra thousands... until Hamilton Standard switched to Cellulubes

At Hamilton Standard, lubrication of a 4200 psi four-stage compressor was a serious problem. Carbon deposits from petroleum lubricants made it necessary to lease a stand-by compressor, and a mechanic was assigned to round-the-clock duty to prevent valve malfunction and spring breakage. Even so, repair bills and maintenance costs ran into large sums of money, and valuable production time was lost. After switching to Cellulube 220, only routine maintenance was required. The formation of petroleum carbon residues ceased, and oil fouling of the compressed air dryer was eliminated. The former constant threat of fire and explosion was also eliminated. Cellulubes made it possible to ship back the stand-by compressor and turn over servicing of the machine to its regular department.

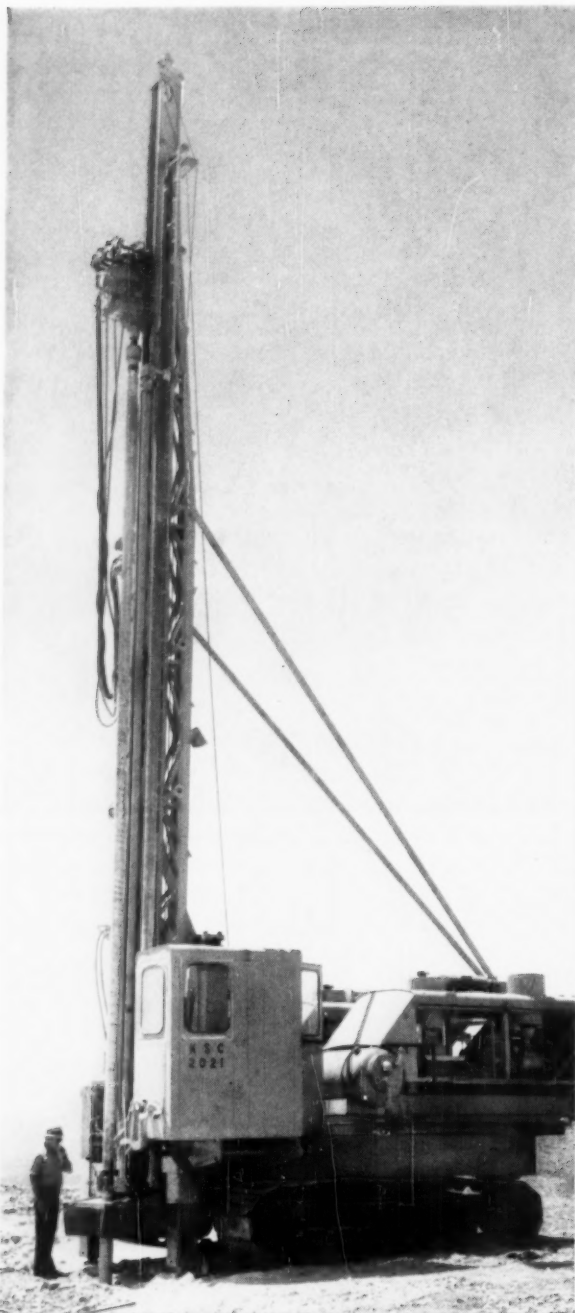
Cellulubes are more than a means of increasing safety. These synthetic lubricants have a cleansing action inside machinery. They give overall wear protection comparable to that of premium petroleum oils. Write for information on how Cellulubes can help you achieve greater efficiency and safety in your plant.

Celanese® Cellulubes®

**CELANESE CHEMICAL COMPANY**  
a Division of Celanese Corporation of America  
Dept. 596-B, 180 Madison Ave., New York 16, N. Y.

Canadian Affiliate: Canadian Chemical Company Limited, Montreal, Toronto, Vancouver.  
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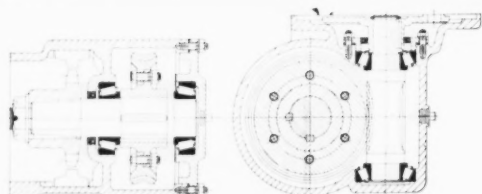
## How Ingersoll-Rand assures accuracy of "Quarrymaster's" drill feed under 900-blow-per-minute drilling

**S**TRIKING 900 blows per minute and drilling through all kinds of hard broken rock formations puts terrific loads on the air motor that feeds the "Quarrymaster" drill. Yet the motor assures accurate, positive control of drill feed; fights a tight steel when drilling broken and seamy ground. One big reason the motor works so dependably is that the worm gear is mounted on Timken® tapered roller bearings. Ingersoll-Rand selected Timken bearings because . . .

1. *They take all loads.* The tapered design of Timken bearings enables them to take *any* combination of radial and thrust loads. And full line contact between rollers and races gives Timken bearings *extra* load-carrying capacity—to take heavy shock loads.
2. *They reduce maintenance, last longer.* Because they hold shafts concentric with their housings, Timken bearings make closures more effective in keeping dirt and moisture out, lubricant in, maintenance down. Bearings and parts last longer.

And Timken bearing-equipped machines give you the extra advantages of Timken Company leadership in tapered roller bearing design plus service from graduate engineer salesmen. Backing this leadership are the most modern testing, research and development facilities in the bearing industry.

*When you buy Timken bearings you get . . . 1) Quality you can take for granted. 2) Service you can't get anywhere else. 3) The best-known name in bearings. 4) The pace setter in lower bearing costs.* The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable: "TIMROSCO". *Makers of Tapered Roller Bearings, Fine Alloy Steels and Removable Rock Bits.*



How Timken bearings are used on the worm drive in Ingersoll-Rand's QM-3-DHD-400 "Quarrymaster"—to take heaviest loads, cut maintenance.

**BETTER-NESS rolls on**  
**TIMKEN®**  
**tapered roller bearings**



